US Army Corps of Engineers

AQUATIC PLANT CONTROL RESEARCH PROGRAM

MISCELLANEOUS PAPER A-88-3

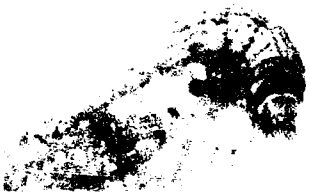
ALLIGATORWEED SURVEY OF TEN SOUTHERN STATES

by

Alfred F. Confrancesco, Jr.

Environmental Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631, Vicksburg, Mississippi 39180-0631



April 1988
Final Report

ENVIRONMENTAL LABORATORY

Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188
Exp Date Jun 30, 1986

1a REPORT SECURITY CLASSIFICATION Unclassified	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b DECLASSIFICATION/DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S) Miscellaneous Paper A-88-3	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION USAEWES Environmental Laboratory 6b OFFICE SYMBOL (If applicable)	7a NAME OF MONITORING ORGANIZATION
6c ADDRESS (City, State, and ZIP Code) PO Box 631 Vicksburg, MS 39180-0631	7b ADDRESS (City, State, and ZIP Code)
8a NAME OF FUNDING/SPONSORING ORGANIZATION US Army Corps of Engineers 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS (City, State, and ZIP Code) Washington, DC 20314-1000	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
Alligatorweed Survey of Ten Southern States

12 PERSONAL AUTHOR(S)
Cofrancesco, Alfred F., Jr.

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Final report	FROM _____ TO _____	April 1988	120

16 SUPPLEMENTARY NOTATION
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Alligatorweed Aquatic plant control Biological control Insects

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

Alligatorweed (*Alternanthera philoxeroides* (Mart.) Griseb.) is an exotic South American plant introduced into the United States prior to 1897. It rapidly developed into problem levels throughout most southern states, where it outcompetes native vegetation and interferes with navigation and recreational use of waterways.

Three biological control agents *Agasicles hygrophila* (Selman and Vogt), *Amynothrips andersoni* (O'Neill) and *Vogtia malloi* (Pastrana) were released in the United States between 1964 and 1970 for the control of alligatorweed. A review of the releases and population development of these insect species was conducted through 1972 by US Department of Agriculture scientists.

The objectives of this study were to: (a) determine the current extent of the alligatorweed population in each state and ascertain whether or not it occurred at problem
(Continued)

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL	22b TELEPHONE (Include Area Code) / 22c OFFICE SYMBOL

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

19. ABSTRACT (Continued).

levels, (b) define the current population levels of biocontrol agents at selected original release sites and assess their impacts on the alligatorweed population, (c) describe the current distribution of each species of biocontrol agent in each state, (d) identify environmental factors influencing the effectiveness of each biocontrol agent, and (e) provide recommendations for managers to enhance the effectiveness of each biocontrol agent in areas where control has not been achieved.

Data indicate that alligatorweed is not a major problem throughout the southeastern United States; however, its population levels do vary between and within states. Louisiana, Florida, and Georgia have only minor alligatorweed problems, which generally are controlled by the biocontrol insects. Alligatorweed problems in Mississippi and Alabama vary greatly between the northern and southern portions of the states. In the northern portions of Mississippi and Alabama, alligatorweed causes problems, but the southern portions of these states have no alligatorweed problems. Alligatorweed occurs as a minor problem in South Carolina, Arkansas, and Tennessee. Texas and North Carolina also have minor problem levels of alligatorweed; however, certain environmental conditions often make these problems more severe.

The distribution of each biocontrol agent varies among states. Both *Agasicles* and Vogtia were found in 7 of the 10 states surveyed. *Agasicles* were absent from Arkansas, North Carolina, and Tennessee, whereas *Vogtia* were absent from Arkansas, Georgia, and Tennessee. Alligatorweed was not found in Tennessee, so it was highly unlikely that any of the biocontrol agents would be found. Literature indicates that *Agasicles* regularly occur in Arkansas, but their population levels must be extremely low. The presence of *Vogtia* in states north, south, and west of Georgia indicates that *Vogtia* probably do occur in Georgia, even though they were not collected in the state. *Amynothrips* were found in only Florida, Louisiana, Mississippi, Alabama, and Texas, and their distribution was usually limited within each state. The *Amynothrips* population found in Alabama and Texas was due to recent releases, and no populations were found in other areas of these states. Florida, Louisiana, and Mississippi have established populations; however, their distribution is also somewhat limited.

Extreme temperature and water fluctuations appear to be the two most important environmental factors influencing the effectiveness of the biocontrol agents. *Agasicles* are unable to regularly impact the aquatic morphotype of alligatorweed in the northern range. Increased *Vogtia* populations occur in the northern states late in the season when alligatorweed biomass is greatest.

Biocontrol agents need to be used as tools for controlling alligatorweed. When the proper conditions exist, insects need to be rapidly introduced so that their growth and impact can be the most productive. In areas where insect populations are established, they must be monitored to ensure high population levels. Considerations should be taken to determine the availability of a mobile biocontrol agent that impacts the terrestrial morphotype of alligatorweed.

PREFACE

This study was conducted by the US Army Corps of Engineers (USACE) under the Aquatic Plant Control Research Program (APCRP). Funds for this study were provided by the USACE, under Department of the Army Appropriation No. 96X3122 Construction General. The principal USACE Technical Monitor for the APCRP was Mr. E. Carl Brown.

The principal investigator for the work and author of this report was Dr. Alfred F. Cofrancesco., Jr., of the Wetland and Terrestrial Habitat Group (WTHG), Environmental Resource Division (ERD), Environmental Laboratory (EL), US Army Engineer Waterways Experiment Station (WES).

The author extends appreciation to Dr. Dana Sanders and Messrs. Edwin A. Theriot, R. Michael Stewart, and Russell F. Theriot for their assistance in the project development and manuscript review. Appreciation is also extended to the following Federal and State personnel who assisted in or gave input to this study: Dr. Joseph Patti, US Army Engineer District (USAED), Savannah; Mr. Clyde Gates, USAED, Little Rock; Mr. Thomas Heineke, USAED, Memphis; Mr. Lee Hunt and Ms. Joyce Johnston, USAED, Galveston; Dr. Glen Muntz and Mr. Frank J. Cali, USAED, New Orleans; Messrs. Michael Eubanks, Angus Gholson, Jr., and Joe Kight, USAED, Mobile; Mr. Edward Moyer, USAED, Dallas-Fort Worth; Messrs. Jim McGhehee and Michael Dupes, USAED, Jacksonville; Mr. Jim Preacher, USAED, Charleston; Drs. Ted Center, Gary Buckingham, and George Vogt, and Mr. Walley Durden, US Department of Agriculture; Messrs. A. Leon Bates and Terry L. Goldsby, Tennessee Valley Authority; Mr. Glen Carowon, US Fish and Wildlife Service; Mr. James Manning, Louisiana Department of Wildlife and Fisheries; Mr. Danny Johnston, South Carolina Water Resource Commission; Mr. Danny Riley, Florida Department of Natural Resources; Mr. Louis V. Guerra, Texas Parks and Wildlife Department; Messrs. Howard Roach and John Inabinet, South Carolina Public Service Authority; and Mr. Fujimoto, Harris County Mosquito Board. The report was edited by Ms. Lee T. Byrne of the WES Information Technology Laboratory.

This study was conducted under the direct supervision of Mr. Edwin A. Theriot and Dr. Hanley K. Smith, Chief, WTHG, and the general supervision of Drs. Conrad J. Kirby, Jr., Chief, ERD, and John Harrison, Chief, EL. Manager of the APCRP at WES was Mr. J. Lewis Decell.

COL Dwayne G. Lee, CE, was the Commander and Director of WES.

Dr. Robert W. Whalin was Technical Director.

This report should be cited as follows:

Cofrancesco, A. F., Jr. 1988. "Alligatorweed Survey of Ten Southern States," Miscellaneous Paper A-88-3, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

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CONVERSION FACTORS, NON-SI TO SI (METRIC)
UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
acres	4,046.873	square metres
miles (US statute)	1.609347	kilometres
yards	0.9144	metres

ALLIGATORWEED SURVEY OF TEN SOUTHERN STATES

PART I: INTRODUCTION

Background

1. Alligatorweed (*Alternanthera philoxeroides* (Mart.) Griseb.) (Figure 1) was introduced into the United States during the late 1890's and was well established in the southeastern states by 1900 (Weldon 1960). In the absence of natural herbivorous enemies, alligatorweed populations increased during the first half of the 20th century and caused significant problems in many waterways of the southeastern United States by 1945. In 1963, an estimated 162,400 acres* of alligatorweed occurred in coastal states from North Carolina to Texas, and small infestations were also reported in Virginia, Arkansas, Tennessee, and California (Massey 1955, Weldon 1960, US Army Corps of Engineers (CE) 1965).

2. Efforts were initiated in 1959 to determine the feasibility of using biological agents to control alligatorweed. Although early efforts included a

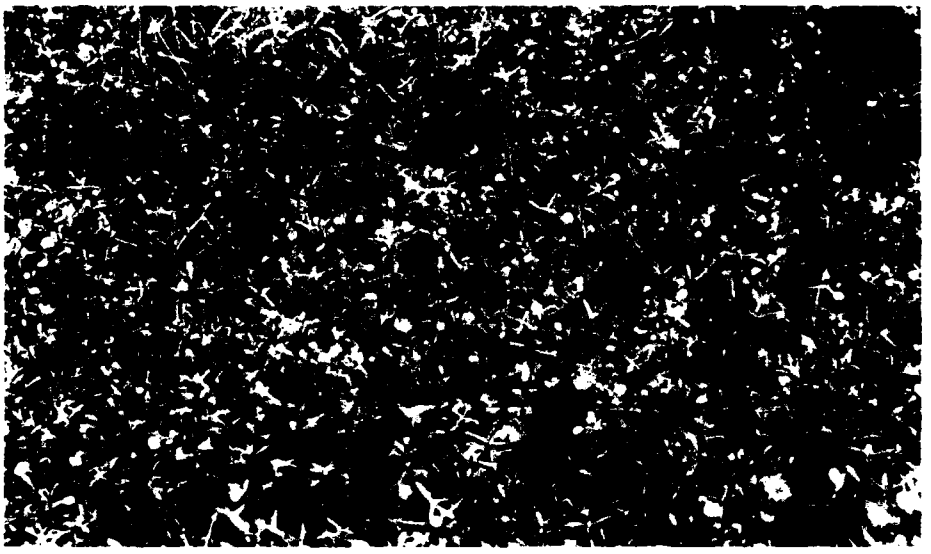

Figure 1. *Alternanthera philoxeroides* ((Mart.) Griseb.) with flower; common name: alligatorweed

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* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 6.

broad spectrum of biological agents, most of the effort centered on the use of arthropods. The US Department of Agriculture, Agricultural Research Service (USDA-ARS), surveyed alligatorweed in South America for candidate biocontrol agents, with funding provided largely by the Aquatic Plant Control Research Program (APCRP), CE. Although a large number of species were found to feed on alligatorweed, the number of viable candidates was reduced to three species, including: the alligatorweed flea beetle (*Agasicles hygrophila* (Selman and Vogt)), alligatorweed thrips (*Amynothrips andersoni* (O'Neill)), and the alligatorweed stem borer (*Vogtia malloi* (Pastrana)). After extensive life history and host specificity studies, *Agasicles* was released in the United States in 1964, *Amynothrips* in 1967, and *Vogtia* in 1971 (Hawkes, Andres, and Anderson 1967; Zeiger 1967; Andres 1971; Goeden and Ricker 1971; Maddox 1970; and Brown and Spencer 1973).

3. Following the initial releases, each species was distributed as a cooperative effort among the USDA-ARS, CE, and other Federal, State, and local agencies charged with aquatic plant control responsibilities. By 1973, *Agasicles* had been released in numerous locations in all the southeastern states and California. However, releases of *Amynothrips* and *Vogtia* were less extensive than releases of *Agasicles*.

4. In 1970, the CE asked the USDA-ARS to evaluate the alligatorweed biocontrol program. In 1977, the USDA-ARS published the report "Biological Control of Alligatorweed, 1959-1972: A Review and Evaluation" (Coulson 1977), which described all documented releases of the biocontrol agents in each state and included a summary of their survival and establishment at release sites. This report also discussed factors influencing establishment. Successful establishment of one or more of the three biocontrol agents occurred in many areas, and the alligatorweed population in the southeastern United States was significantly reduced, but not eliminated. In some areas, biocontrol agents never became established, or long-term control was never achieved because climatic conditions precluded overwintering.

5. No concerted effort has been made since 1972 to document the effectiveness of these biocontrol agents on alligatorweed throughout the southeastern United States, although Vogt, Quimby, and Kay (in press) evaluated their effectiveness in the Lower Mississippi Valley region. In recent years, alligatorweed problems have increased in areas where initial efforts to

establish biocontrol agents were unsuccessful or the biocontrol agents failed to overwinter.

The Biocontrol Agents

Alligatorweed flea beetle

6. The alligatorweed flea beetle (Figure 2) was approved for release in 1963. It has a 30-day life cycle (Maddox 1968), and both adults and larvae feed on the plant. Adults feed on mature leaves, and females lay eggs on the lower leaf surface. Larvae produce circular feeding pits on the lower leaf surface and also feed on the stem. The flea beetle feeds preferentially and completes its life cycle only on the aquatic form* of alligatorweed. The aquatic plant form has a soft, inflated stem with a hollow center, where the larvae feed and pupation occurs. The terrestrial form has a more fibrous stem and an almost solid center, which is not conducive to pupation.

Figure 2. *Agasicles hygrophila* (Selman and Vogt) adult; common name: alligatorweed flea beetle

* There are two morphotypes (plant growth forms) of alligatorweed. The aquatic morphotype is characterized by hollow stems, whereas the terrestrial morphotype has solid or nearly solid stems. Subsequent reference to morphotype in the text and Appendix A follow these definitions.

7. Initial releases of the alligatorweed flea beetle were made in California and South Carolina (1964), followed by releases in Florida and Mississippi (1965), Georgia (1966), Texas, North Carolina, and Alabama (1967), Tennessee (1968), Arkansas (1969), and Louisiana (1970). Significant impacts on alligatorweed were noted after populations had become established, and the greatest impacts occurred in areas where the population peaked in early June. Such population peaks were closely correlated with environmental factors (e.g., temperature) and occurred in an area along and south of a line from Savannah, Ga., to Jasper, Tex. (Coulson 1977).

Alligatorweed thrips

8. The alligatorweed thrips (Figure 3) was approved for field release in 1966. Its life cycle requires approximately 28 days (Maddox and Mayfield 1979), and both nymphs (juvenile stage) and adults feed on alligatorweed with their sucking mouth parts. Damage most often occurs on the newest leaf tissue in the plant crown. Affected leaves dry and curl, and the thrips may often be found on these curled leaves.

9. Initial releases of alligatorweed thrips were made in California, South Carolina, Florida, and Georgia in 1967. These releases were followed by others in Mississippi and Texas (1968) and Alabama (1969). Although the effectiveness of this biocontrol agent in the United States has not been well documented, the effectiveness of the thrips was observed to increase in the

Figure 3. *Amonythrips andersoni* (O'Neill) larvae; common name: alligatorweed thrips

presence of *Agasicles*, based on South America studies (Silveira 1962 and 1963, as cited in Coulson 1977).

Alligatorweed stem borer

10. The alligatorweed stem borer (Figure 4) was approved for release in the United States in 1970. It has a life cycle of approximately 39 days (Maddox 1970), and only the larvae feed on alligatorweed. Feeding occurs within the hollow, inflated stems of the aquatic form of alligatorweed, causing a reduction in nutrient flow. This process usually starts at the apical portion of the plants. Infested stems often appear wilted, become desiccated, and fall over.

11. Stem borer releases were made in Florida, Georgia, North Carolina, and South Carolina in 1971 and in Alabama in 1972. Limited information has been obtained on stem borer effectiveness. It was thought that the stem borer might become more widespread than the other biocontrol agents because of its ability to survive the colder winters that occur at the northern limits of the range of alligatorweed.

Purpose

12. The purpose of this study was to determine the status of alligatorweed and biocontrol agents in the southeastern United States 10 years after

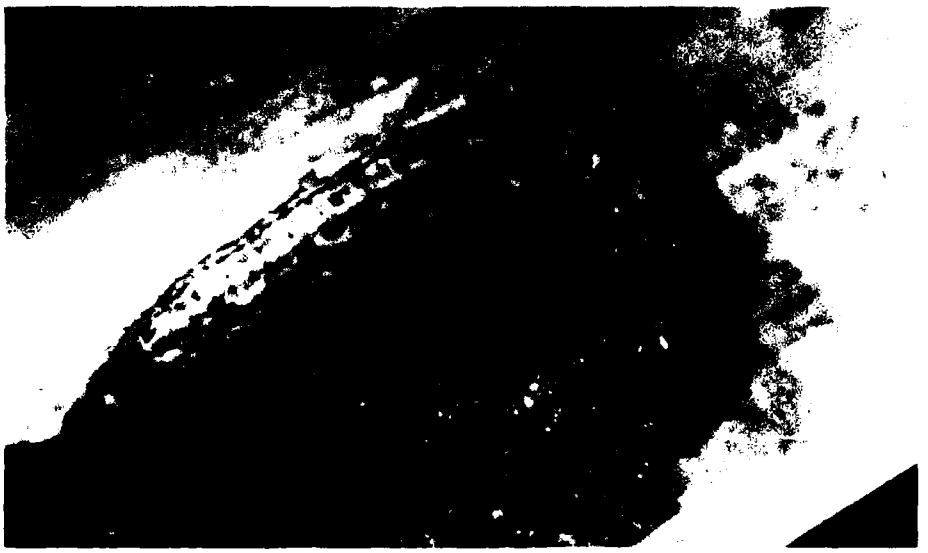


Figure 4. *Vogtia malloi* (Pastrana) larvae; common name: alligatorweed stem borer

the initial distribution was completed. This report describes the results of the survey and includes recommendations for increasing the effectiveness of the biocontrol agents.

Approach and Objectives

Approach

13. The approach of the study was to survey selected original release sites of the biocontrol agents in the southeastern states and to document the status of both alligatorweed and the biocontrol agents. In addition, Federal and State agencies were to be surveyed to determine the current extent of the alligatorweed population in each state. Based on findings, recommendations were to be made to increase the effectiveness of the biocontrol agents.

Objectives

14. Specific objectives of the study were to:

a. Determine the current extent of the alligatorweed population in each state and ascertain whether or not it occurred at problem levels.

b. Define the current population levels of biocontrol agents at selected original release sites and assess their impacts on the alligatorweed population.

c. Describe the current distribution of each species of biocontrol agent in each state.

d. Identify environmental factors influencing the effectiveness of each biocontrol agent.

e. Provide recommendations for managers to enhance the effectiveness of each biocontrol agent in areas where effective control has not been achieved.

PART II: METHODS

15. Two methods were used to determine the status of the insect species impacting alligatorweed. The first method consisted of a survey of State and Federal agencies involved in aquatic plant management. These agencies were asked to address both past and present conditions of the alligatorweed populations and the biocontrol insect populations in their areas. The survey sheet is presented in Figure 5, and a list of contacted State and Federal agencies is shown in Table 1.

DATA REQUEST FORM

Agency _____ Date _____

State Covered _____

1. What is or has been the acreage of alligatorweed in your area of responsibility and how many acres of alligatorweed were treated with methods other than biocontrol agents during the years shown below: If chemicals were employed, please specify name.

Year	Acres of Alligatorweed	Acres Treated	Method Employed
1972			
1973			
1974			
1975			
1976			
1977			
1978			
1979			
1980			
1981			

Figure 5. Data request form submitted to State and Federal agencies (Continued)

2. What is the present estimation of the severity of the alligatorweed problem (Please circle one response).

A. Very serious problem

B. Locally serious problem

C. Of concern but not serious

D. Not considered to be a problem

3. Over the last ten years, has the population levels of alligatorweed been: (Please circle one response).

A. Increasing

B. Decreasing

C. Stable

4. What level of alligatorweed control are the insect biocontrol agents producing in your area?

Excellent _____

Satisfactory _____

Marginal _____

Unsatisfactory _____

No control provided _____

5. What factors may be reducing the effectiveness of biocontrol agents in your area? (e.g., low temperature in winter, flooding, drought).

_____

_____

Figure 5. Data request form (Concluded)

16. The second method involved a field survey of selected sites in each of 10 southeastern states (Figure 6). Site selection in each state was based on three factors: (a) total alligatorweed acreage, (b) number of original insect release sites, and (c) geographic distribution of alligatorweed. Each site was examined in June and October of 1982.

17. Field sites were classified into two major types: primary and secondary. Primary sites were selected so that the all geographic areas within a state were examined. The USDA Technical Bulletin No. 1547 (Coulsen 1977) was used to determine sites that had previously had alligatorweed and at which insect releases had been made. Accuracy of primary site locations varied, depending on the amount of available information. Thus, alternate primary sites were identified to ensure that each geographic area within a state was covered. Thus, some primary sites were not original release sites. Secondary sites were those areas that, during the course of travel from one primary site to another, were observed to have alligatorweed. Also, some secondary sites were near original release sites that were too vaguely described for exact location. The schedule of site visits for the June survey

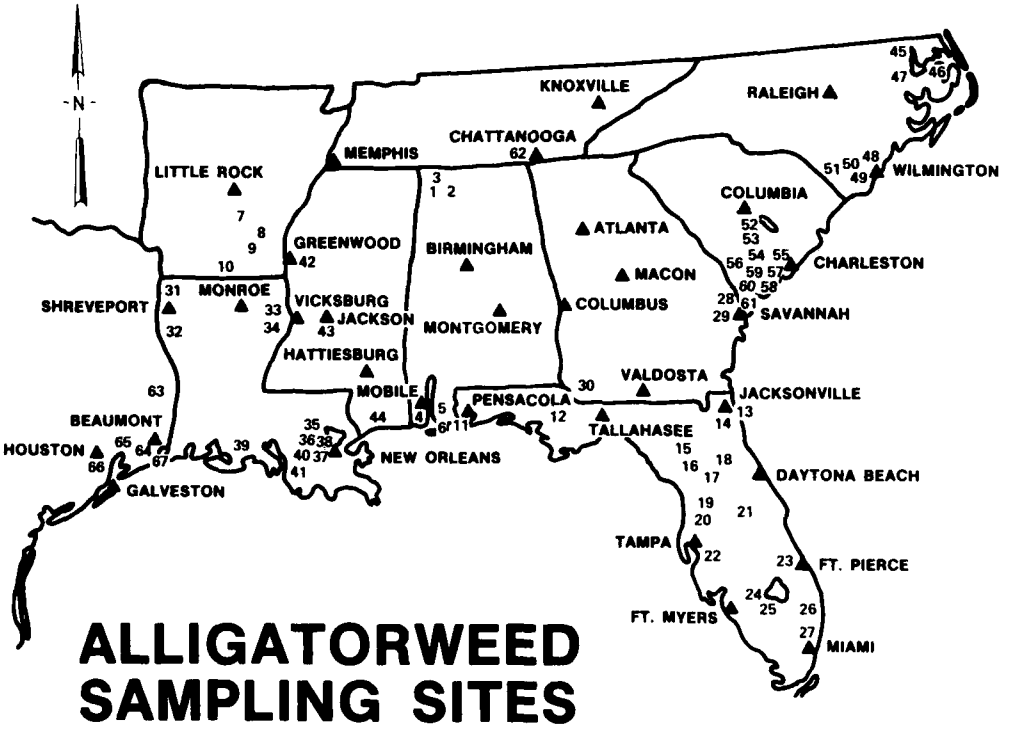


Figure 6. Locations of primary sites in the 10 surveyed states. Numbers are coded to site descriptions provided in Part III and Appendix A

Table 1

List of State and Federal Agencies That Contributed Data to This Study

US Army Engineer District, Mobile	US Army Engineer District, Wilmington
Tennessee Valley Authority, Water Quality and Ecology Branch	North Carolina Department of Agriculture, Biological Laboratory
US Army Engineer District, Little Rock	US Army Engineer District, Charleston
US Army Engineer District, Jacksonville	South Carolina Water Resource Commission
State of Florida Bureau of Aquatic Plant Resource and Control	US Army Engineer District, Nashville
US Army Engineer District, Savannah	US Army Engineer District, Galveston
State of Georgia Game and Fish Division	US Army Engineer District, Fort Worth
US Army Engineer District, New Orleans	Texas Noxious Vegetation Control Program, Braniff Laboratory
Louisiana Department of Wildlife and Fisheries	
Mississippi Department of Natural Resources	

was arranged so that the southernmost sites were examined first; then the schedule was reversed in October, when the northern sites were visited first. During the field surveys, 67 primary sites and 35 secondary sites were examined.

18. At each primary site, the abundance of alligatorweed was recorded (heavy, moderate, sparse, or absent), along with morphotype (terrestrial or aquatic), vigor (healthy, stunted, or chlorotic), and total acreage. The population densities of *Agasicles*, *Amynothrips*, and *Vogtia* were evaluated as heavy, moderate, sparse or absent. Sweep nets were used for *Agasicles* collections, and stems were examined for the presence of *Amynothrips* and *Vogtia*.

19. Observations on secondary sites included an estimate of the acreage of alligatorweed, plant vigor, and status of the biocontrol insects. Evaluation of insect populations at these sites involved examination of the vegetation for damage and visual estimates of the biocontrol agent populations.

PART III: RESULTS

20. The results of the study are presented in two parts: (a) information obtained from the survey of agencies and (b) information obtained from the field surveys.

Survey of Agencies

21. Responses from State and Federal agencies having aquatic plant responsibilities in the same geographic area were similar for most questions. The responses of all State and Federal agencies to each question are summarized in the following paragraphs. In presenting the data, information obtained from Federal agencies with areas of responsibility covering more than one state was adjusted so that data could be presented for each state.

22. The first question asked for three types of data about alligatorweed in the area of responsibility during 1972-1981: (a) total acreage of alligatorweed, (b) total acreage treated (other than biological), and (c) the method of treatment (other than biological). Four agencies supplied acreage figures for 1972 through 1981, eight agencies provided acreages for selected years, and six agencies provided no acreage figures.

23. Except for Louisiana, Texas, and the Tennessee Valley Authority (TVA), all contacted agencies reported a decrease in acreages of alligatorweed as compared with the 1963 acreage recorded by Coulson (1977) (Table 2). The only control method reported, other than biological, was chemical (Diquat and 2,4-D). Most chemical control efforts were performed incidental to waterhyacinth control programs, and no agency reported any chemical control efforts directed specifically toward alligatorweed.

24. Question two addressed the current severity of alligatorweed. Possible responses included: (a) very serious problem; (b) locally serious problem; (c) of concern, but not serious; and (d) not considered to be a problem. None of the responding agencies indicated that alligatorweed was a very serious problem. The usual responses consisted of "a locally serious problem" and "of concern, but not serious." Arkansas did not consider alligatorweed to be a problem. No significant pattern of responses was noted along geographic lines. However, alligatorweed is not considered to be a major problem by any of the contacted agencies (Figure 7).

Table 2

Total Acreage of Alligatorweed by State for 1963 and 1981

State	1963*	1981
Alabama (south)	4,650**	-
Arkansas	122	50
Florida	2,600	950†
Georgia	1,800	100
Louisiana	56,000	169,000
Mississippi	52	-
North Carolina	376	-
South Carolina	30,000	2,000
Tennessee	60	-
Texas	1,200	18,000
TVA (northern Alabama)	>200††	825

* As reported in Coulsen 1977.
** Total minus 200 acres in northern Alabama in the TVA system.
† Acreage for lakes and rivers greater than 100 acres.
†† Northern Alabama acreage.

25. Question three addressed trends in the alligatorweed population during 1972-1981. Three possible answers were provided: (a) increasing, (b) decreasing, and (c) stable. No pattern of responses was observed for this question. The alligatorweed population was reported to be stable in Florida, Louisiana, and North Carolina. Decreasing populations of alligatorweed were reported by agencies for the states of Alabama, Arkansas, Mississippi, South Carolina, and Tennessee, but the responses from agencies in Georgia, Texas, and the TVA indicated increasing alligatorweed populations (Figure 8).

26. Question four considered the degree of alligatorweed control being provided by the biocontrol agents, with five possible answers: (a) excellent, (b) satisfactory, (c) marginal, (d) unsatisfactory, and (e) none. A definite geographic pattern was observed in the responses to this question, with the southern areas reporting more control. Agencies in Florida reported satisfactory to excellent control, and those in Louisiana, Mississippi, and Arkansas responded that alligatorweed control was satisfactory. Control in South

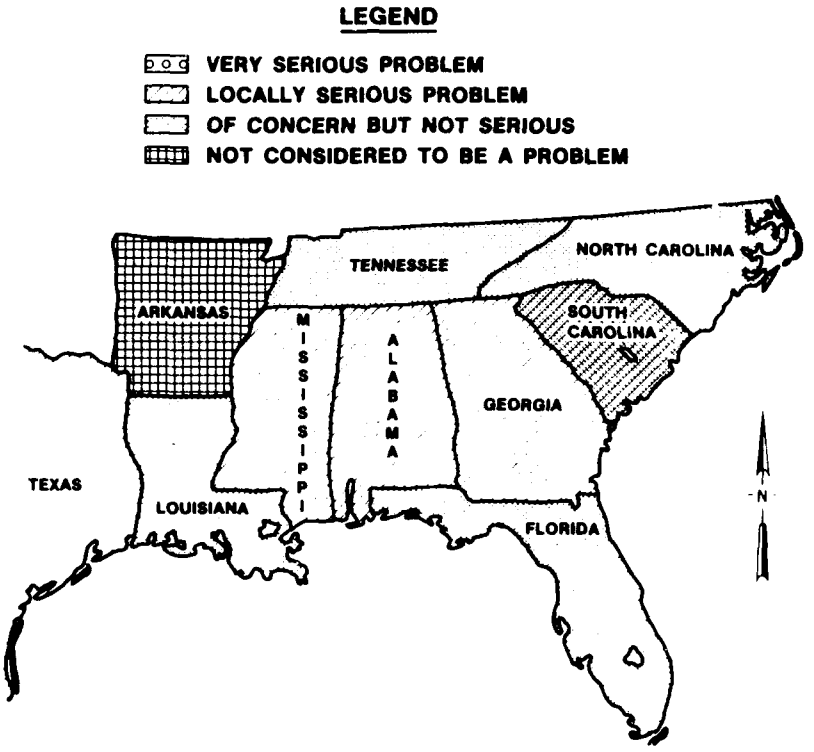


Figure 7. Responses to the question: What is your estimation of the present severity of alligatorweed?

Carolina ranged from marginal to satisfactory. Marginal control was reported by agencies in Texas, Alabama, and Georgia. Control was reported to be unsatisfactory in Tennessee and the TVA, and no control of alligatorweed by biocontrol insects occurred in North Carolina (Figure 9).

27. Question five requested the agencies' opinions as to the factors, if any, that might limit the effectiveness of biocontrol insects. Most agencies indicated that environmental factors (e.g., low temperature, droughts, and flooding) influenced the impact of these biocontrol agents. Pesticide use in surrounding agricultural areas was also mentioned as a possible limiting factor.

Field Survey

28. A summary of field data collected from each state is presented in this section; data obtained from individual sites are presented in Appendix A.

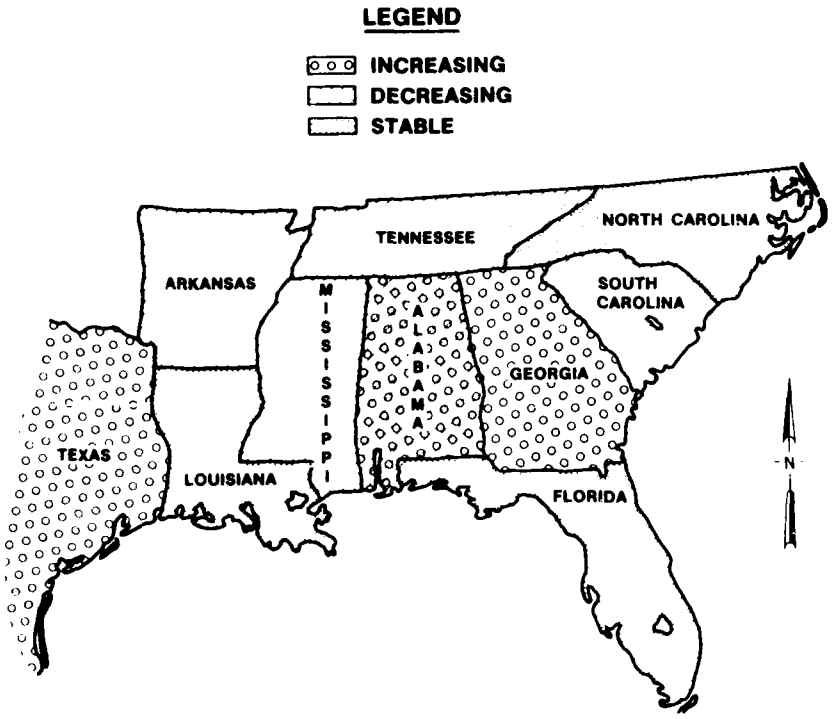


Figure 8. Federal and State responses to the question: Over the last 10 years, have the population levels of alligatorweed been increasing, decreasing, or stable?

Alabama

29. June. In Alabama, both morphotypes of alligatorweed were found at the three northernmost sites (1, 2, and 3),* with the aquatic morphotype being the most abundant (Figure 10a). *Agasicles* were collected at both Steenson Hollow (2) and Woodlawn Springs (3), but *Amynothrips* were collected only at Cane Creek (1). *Vogtia* were not collected at any of the three sites (Table 3). In the southern portion of the state, alligatorweed mats at Bolton Branch (Figure 11a) and Gulf Shores Park (6) consisted of both the aquatic and terrestrial morphotypes, but the Foley site (5) had only the terrestrial morphotype. The only biocontrol insects collected at the southern sites were *Agasicles* obtained from the two sites having the aquatic morphotype of alligatorweed.

* Site numbers correspond to those shown in Figure 6.

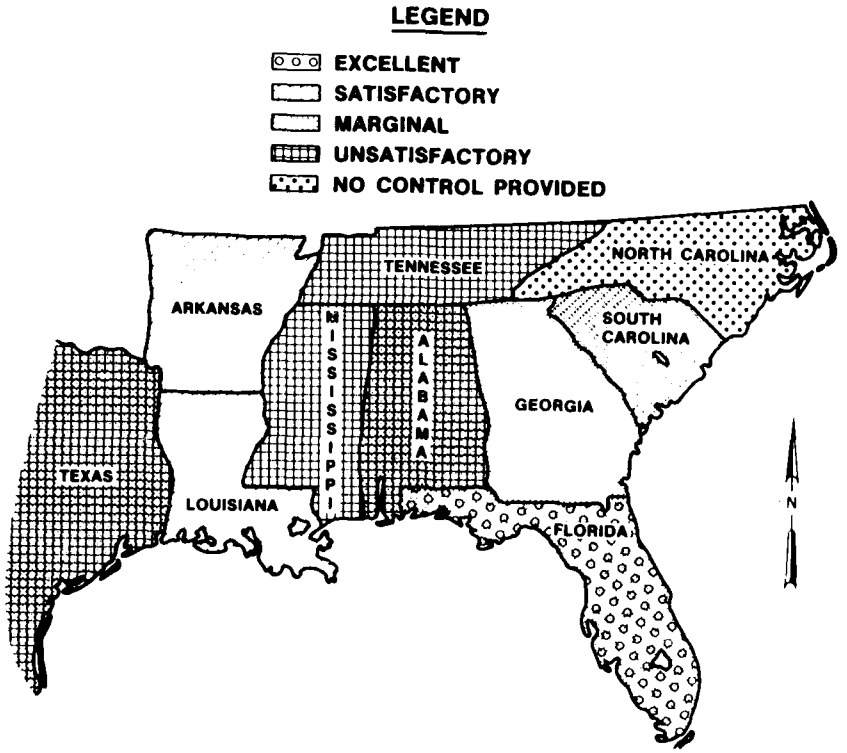


Figure 9. Federal and State responses, to the question: What level of alligatorweed control are the insect biocontrol agents producing in your area?

30. October. The amount of aquatic alligatorweed present at Steenson Hollow (Figure 10b) and Woodlawn Springs was greatly reduced. *Agasicles* were found at all three northern sites, but *Vogtia* were collected only at Cane Creek and Woodlawn Springs. Terrestrial alligatorweed was present at all three northern sites; however, *Amynothrips* and webworms were impacting the alligatorweed only at Cane Creek and Woodlawn Springs. Aquatic alligatorweed was present in very low levels at both the southern sites where it had previously been reported (4 and 6) (Figure 11b). Sampling for biocontrol agents from the sparse amount of aquatic alligatorweed yielded no biocontrol insects. Webworms were collected in low numbers at the Foley site, which had only terrestrial alligatorweed; however, its impact was minimal.

Arkansas

31. June. Both the aquatic and terrestrial morphotypes of alligatorweed were found at three of the four sites visited (Figure 12a). Bayou Meto State Park (8) had only the aquatic morphotype (Table 4). None of the

a. Alligatorweed was present at the site in June 1982. TVA biologists had released *Agasicles* at this site in May 1982

b. Same site in October 1982, with severe damage to the alligatorweed population

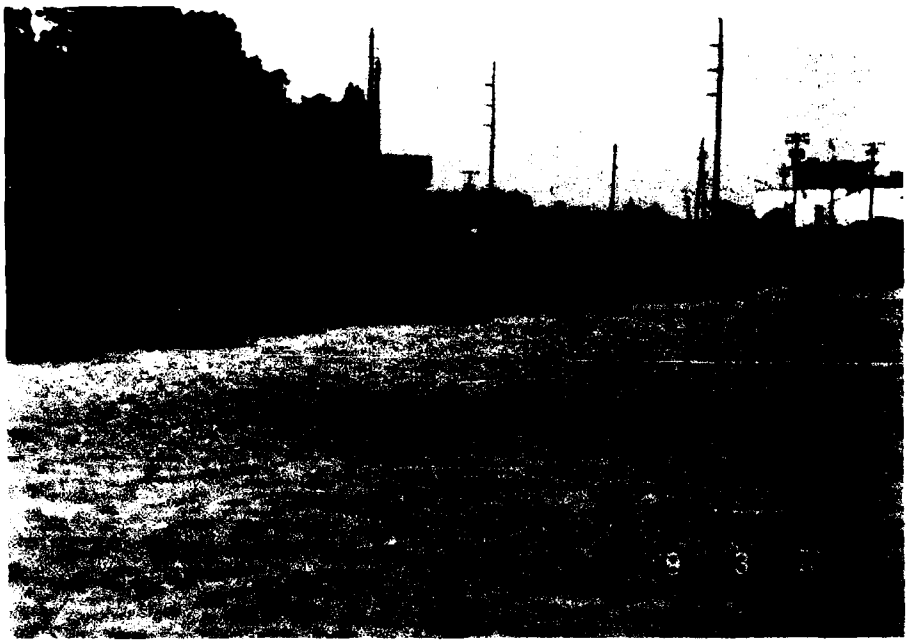
Figure 10. Site 2--Steenson Hollow (Wilson Lake, Colbert County), Alabama

Table 3

Summary of Plants and Insects Surveyed in Alabama

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
1	Cane Creek (discharge pond)	Spa*	Spa	Mod	Mod	Abs	Spa	Abs	Spa	Abs	Mod
2	Steenson Hollow, Wilson Lake	Spa	Spa	Mod	Spa	Mod	Spa	Abs	Abs	Abs	Abs
3	Woodlawn Springs	Spa	Spa	Mod	Spa	Mod	Mod	Spa	Mod	Abs	Mod
4	Bolton Branch at Highway 90	Spa	Spa	Mod	Abs	Mod	Abs	Abs	Abs	Abs	Abs
5	Foley	Hev	Hev	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
6	Gulf Shores Park	Spa	Spa	Mod	Abs	Spa	Abs	Abs	Abs	Abs	Abs
S-1	Three locations on Guntersville Lake	Spa	Mod	Spa	Mod	Abs	Abs	Abs	Abs	Abs	Abs

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.



a. Alligatorweed (upper left) in June 1982 growing from the bank into the water

b. No aquatic alligatorweed present in October 1982

Figure 11. Site 4--Bolton Branch (Mobile County), Alabama

a. Alligatorweed in June 1982 growing out from the bank as a fringe of vegetation around the entire site

b. The alligatorweed mat still present in October 1982 with no insect damage

Figure 12. Site 9--Moody Old River (Arkansas County), Arkansas

Table 4

Summary of Plants and Insects Surveyed in Arkansas

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
7	Bayou Bartholomew	Spa*	Spa	Mod	Mod	Abs	Abs	Abs	Abs	Abs	Abs
8	Bayou Meto State Park	Abs	Abs	Spa	Abs	Abs	Abs	Abs	Abs	Abs	Abs
9	Moody Old River	Spa	Spa	Hev	Hev	Abs	Abs	Abs	Abs	Abs	Abs
10	Crossett (Lucas Pond)	Spa	Spa	Hev	Hev	Abs	Abs	Abs	Abs	Abs	Abs
S-2	Bayou Bartholomew west of Pine Bluff	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-3	Bayou Bartholomew south of Pine Bluff	-	Abs	-	Hev	-	Abs	-	Abs	-	Abs
S-4	Egg Lake near Pine Bluff	-	Spa	-	Mod	-	Abs	-	Abs	-	Abs
S-5	Roadside ditch along Ark Highway 35	Mod	Mod	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-6	Roadside ditch near Strong	Mod	-	Abs	-	Abs	-	Abs	-	Abs	-

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

alligatorweed biocontrol agents were collected from any of the sites. *Agasicles*-type feeding damage was observed at Bayou Bartholomew (7) and Crossett (10); however, none of the flea beetle life stages were found (Table 4).

32. October. Both the aquatic and terrestrial morphotypes were again found at the same three sites. The small mat of aquatic alligatorweed previously found at Bayou Meto State Park was removed, probably by water flow from the control structure. *Agasicles, Vogtia,* or *Amynothrips* were not found at any of the sites; however, *Agasicles*-type feeding was again noted at Bayou Bartholomew. Native webworm damage was observed at the Moody Old River (9) (Figure 12b) and Crossett sites; however, damage was minimal.

Florida

33. June. Aquatic and terrestrial morphotypes of alligatorweed were found at both of the northwest Florida sites examined (11 and 12), with the aquatic morphotype being more prevalent (Figure 13a). Only *Agasicles* was found in low numbers at the Pensacola site (11) (Table 5).

34. Nine sites were surveyed in the region between Jacksonville and Enterprise. Both aquatic and terrestrial alligatorweed were present at six of the sites. Dunnellon (19) and Enterprise (21) lacked alligatorweed, and Hastings (18) had only the terrestial morphotype. The aquatic form of alligatorweed was the most prevalent. *Agasicles* were present at five of the seven sites (Figure 14a) that had the aquatic form of alligatorweed, but *Vogtia* were collected only at the two Jacksonville sites (Figure 15a). *Amynothrips* occurred in moderate numbers at the Ortega River site (13) in Jacksonville.

35. Six sites were examined in the southern portion of the state. Terrestrial alligatorweed occurred at four sites, but aquatic alligatorweed was the dominant morphotype at five sites. *Agasicles* were found at all sites having the aquatic form of alligatorweed, and *Vogtia* were also collected at four of the same sites. No *Amynothrips* were collected at any site.

36. October. The terrestrial morphotype of alligatorweed remained at about the same level as was recorded during the June samples for the northwest Florida sites; however, the amount of aquatic alligatorweed was generally reduced at these sites. *Agasicles* was the only insect species collected, and it had apparently devastated the plants, particularly at the Blountstown site (12) (Figure 13b).

37. Aquatic alligatorweed was absent from five of the seven sites in the middle region (Jacksonville to Enterprise), where it had been reported in

a. Alligatorweed in June 1982. Plants are healthy and lack insect damage

b. Alligatorweed in October 1982 was greatly reduced and almost eliminated

Figure 13. Site 12--Blountstown (Calhoun County), Florida

Table 5

Summary of Plants and Insects Surveyed in Florida

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	June	Oct
11	Pensacola (Bayou Chico)	Spa*	Spa	Mod	Spa	Spa	Mod	Abs	Abs	Abs	Abs
12	Blountstown	Spa	Spa	Hev	Abs	Abs	Spa	Abs	Abs	Abs	Abs
13	Jacksonville (Ortega River)	Spa	Spa	Mod	Spa	Mod	Spa	Mod	Spa	Mod	Abs
14	Jacksonville	Spa	Spa	Mod	Abs	Mod	Abs	Abs	Abs	Spa	Abs
15	Lake Alice (Gainesville)	Spa	Spa	Spa	Abs	Mod	Abs	Abs	Abs	Abs	Abs
16	Gainesville (Winn Dixie)	Abs	Abs	Mod	Spa	Abs	Spa	Abs	Abs	Abs	Spa
17	Cross Creek	Spa	Spa	Spa	Abs	Spa	Abs	Abs	Abs	Abs	Abs
18	Hastings (Deep Creek)	Spa	Spa	Abs	Mod	Abs	Spa	Abs	Abs	Abs	Abs
19	Dunnellon	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
20	Withlacoochee River at Ruthland	Spa	Spa	Hev	Abs	Mod	Abs	Abs	Abs	Abs	Abs

(Continued)

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

Table 5 (Continued)

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
21	Enterprise	Abs*	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
22	Tampa (Rowlett Park)	Spa	Spa	Mod	Mod	Spa	Hev	Abs	Abs	Abs	Abs
23	Ft. Pierce Header Canal	Spa	Spa	Mod	Spa	Mod	Spa	Abs	Abs	Spa	Abs
24	Moore Haven	Spa	Abs	Spa	Abs	Mod	Abs	Abs	Abs	Spa	Abs
25	Clewiston	Abs	Abs	Spa	Spa	Spa	Mod	Abs	Abs	Spa	Abs
26	Delray Beach	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
27	Ft. Lauderdale	Spa	Spa	Mod	Mod	Mod	Abs	Abs	Abs	Mod	Mod
S-7	Appalachicola River (Blountstown)	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-8	Drainage Ditch north of Blountstown	Spa	Spa	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-9	Black Creek near Russel		Mod		Spa		Spa		Abs		Spa
S-10	Drainage ditches Green Cove Springs		Mod		Abs		Abs		Abs		Abs

(Continued)

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

Table 5 (Concluded)

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
S-11	Drainage ditches near Hastings		Mod		Abs		Abs		Abs		Abs
S-12	Road side ditch near Spuds	Mod*	Mod	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-13	Drainage system Reading Rocking Horse Road		Spa		Hev		Mod		Abs		Abs
S-14	St. Johns River near Palatka	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-15	Drainage ditch south of Gainesville	Mod	Mod*	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-16	Isla Apopka Lake east of Inverness	Spa	Mod	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-17	Farm Pond near Brooksville	Abs	Abs	Spa	Abs	Mod	Abs	Abs	Abs	Abs	Abs
S-18	Robus Park in Tampa		Spa		Hev		Hev		Abs		Abs
S-19	Lake Trafford near Immokalee	Spa		Mod		Spa		Abs		Abs	
S-20	Canal near Yeehaw Junction	Abs		Spa		Spa		Abs		Abs	
S-21	Canal near Riveria Beach	Spa		Hev		Hev		Abs		Abs	

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

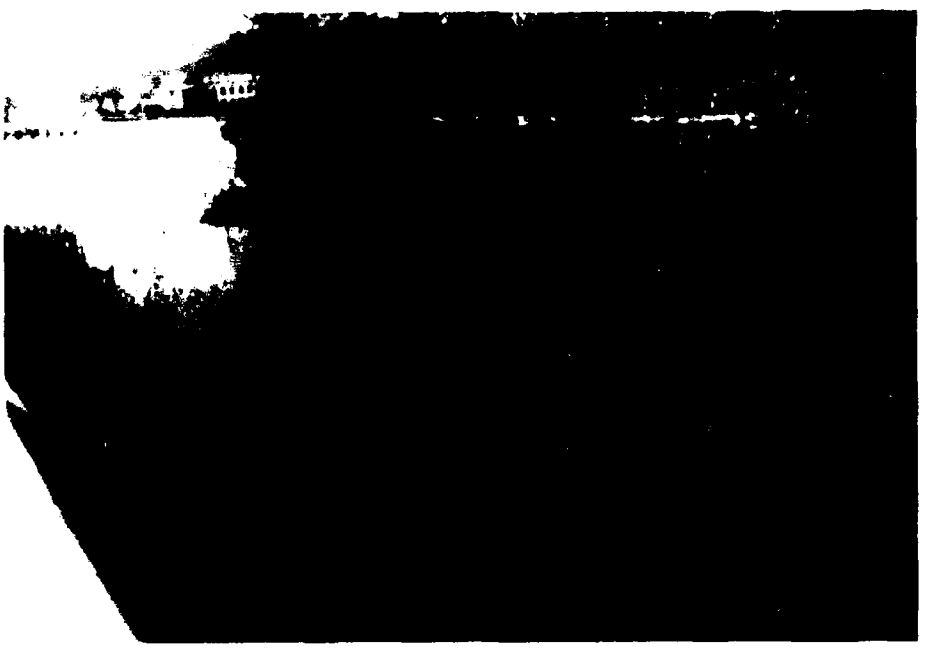
(Sheet 3 of 3)

a. The aquatic morphotype of alligatorweed was severely damaged by *Agasicles* in June 1982

b. Alligatorweed was absent from the site in October 1982, and *Hydrocotyle* had taken over the area

Figure 14. Site 15--Lake Alice (Alachua County), Florida

a. Aquatic alligatorweed impacted by *Vogtia* and *Agasicles* in June 1982



b. The same area in October 1982 with no aquatic alligatorweed being found

Figure 15. Site 13--Jacksonville (Ortega River, Duval County), Florida

June (Figures 14b and 15b). Terrestrial alligatorweed was eliminated from two of the seven sites where it had been observed during the first trip. *Agasicles* were present at only three sites; however, the lack of aquatic alligatorweed probably contributed to their reduction. *Amynothrips* were found at Ortega River (13) in Jacksonville, and *Vogtia* were collected at the Winn Dixie site (16) in Gainesville.

38. Most southern sites that had terrestrial and/or aquatic alligatorweed in June still had alligatorweed populations at the same level. *Agasicles* were found at three sites, but *Vogtia* were found only at Fort Lauderdale (27). *Amynothrips* were not found at any southern site.

39. General. Aquatic alligatorweed was observed at 14 of 17 sites visited in June. In October, aquatic alligatorweed was eliminated from seven sites, reduced at three sites, stabilized at three sites, and increased at only one site.

Georgia

40. June. Both the terrestrial and aquatic morphotypes of alligatorweed were present at all sites visited in Georgia (Figure 16). *Agasicles* were collected only at Ebenezer Landing (28). Neither *Vogtia* nor *Amynothrips* were collected (Table 6).

41. October. The terrestrial alligatorweed remained at approximately the same level in October as had been observed in June. The aquatic alligatorweed had been significantly impacted, especially at Ebenezer Landing and Bainbridge (30). *Agasicles* was the only biocontrol insect collected, and it was found at all three sites.

Louisiana

42. June. Terrestrial alligatorweed was found at all four sites visited in northern Louisiana (31, 32, 33, 34). Aquatic alligatorweed was found at all sites except Tallulah (33) (Table 7). The abundance of alligatorweed varied among sites; however, problem levels occurred only at Lake Bushy (34). Biocontrol insects were found at only this site (34), where both *Agasicles* and *Vogtia* were collected.

43. All seven sites examined in the southern portion of the state had both terrestrial and aquatic forms of alligatorweed (Figures 17a and 18a). *Vogtia* appeared to be the dominant insect species, being collected at six of the seven sites. *Agasicles* were collected at five sites, and *Amynothrips* were found only at Ruddock Canal (35).

Figure 16. Site 28--Ebenezer Landing (Effingham County), Georgia. A vigorous growth of the terrestrial morphotype of alligatorweed without any insect damage

44. October. Terrestrial alligatorweed at the northern sites had increased from June, but aquatic alligatorweed had decreased in abundance. The amount of aquatic alligatorweed present at Logansport (32) and Lake Bushy was reduced; however, this reduction was primarily due to decreased water levels. Many plants at these sites developed characteristics of the terrestrial morphotype in response to the reduced water levels. None of the biocontrol agents were collected from any of the sites; however, a native webworm species was found to be minimally impacting alligatorweed at Lake Bushy.

45. The amount of terrestrial alligatorweed generally remained unchanged in the southern sites, but aquatic alligatorweed was greatly reduced in October (Figures 17b and 18b) at all seven sites and was completely eliminated at three. *Agasicles* were found at all four sites having aquatic alligatorweed, but Vogtia were collected only at Shell Bank Bayou (36). *Amynothrips* were not collected at any site.

Mississippi

46. June. Terrestrial and aquatic forms of alligatorweed occurred at only one of the three primary sites, Jackson Sewage Treatment Plant (43), but

Table 6

Summary of Plants and Insects Surveyed in Georgia

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
28	Ebenezer Landing	Hev*	Hev	Mod	Abs	Spa	Spa	Abs	Abs	Abs	Abs
29	Garden City	Spa	Spa	Mod	Spa	Abs	Spa	Abs	Abs	Abs	Abs
30	Bainbridge (Jim Woodruff Reservoir)	Spa	Spa	Mod	Spa	Abs	Spa	Abs	Abs	Abs	Abs

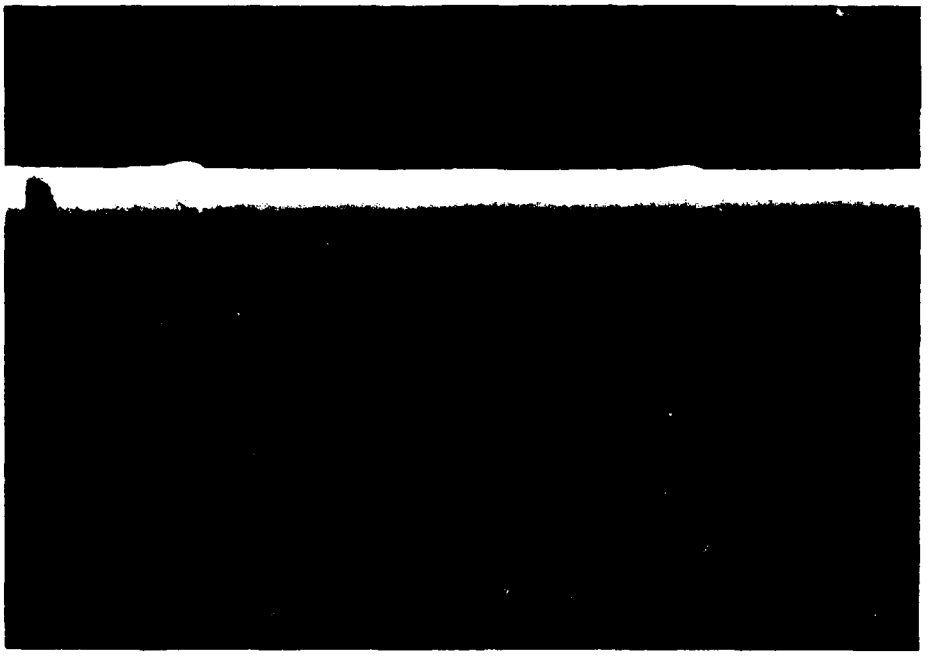
* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

Table 7

Summary of Plants and Insects Surveyed in Louisiana

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
31	Black Bayou	Mod*	Spa	Spa	Spa	Abs	Abs	Abs	Abs	Abs	Abs
32	Logansport	Spa	Spa	Spa	Abs	Abs	Abs	Abs	Abs	Abs	Abs
33	Tallulah (Round-away-Bayou)	Spa	Spa	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
34	Lake Bushy	Spa	Hev	Hev	Spa	Spa	Abs	Abs	Abs	Spa	Abs
35	Ruddock Canal	Spa	Spa	Hev	Spa	Abs	Mod	Spa	Abs	Mod	Spa
36	Shell Bank Bayou	Spa	Spa	Hev	Spa	Abs	Mod	Abs	Abs	Mod	Mod
37	Norco (US Hwy 61)	Spa	Spa	Hev	Abs	Spa	Abs	Abs	Abs	Mod	Abs
38	Cross Canal (US Hwy 61)	Spa	Spa	Mod	Abs	Spa	Abs	Abs	Abs	Mod	Abs
39	Kaplan	Spa	Spa	Hev	Mod	Abs	Mod	Abs	Abs	Spa	Abs
40	Thibodaux	Spa	Spa	Mod	Abs	Mod	Abs	Abs	Abs	Abs	Abs
41	Gibson	Spa	Spa	Hev	Spa	Mod	Mod	Abs	Abs	Spa	Abs
S-22	Drainage ditches south of Kaplan	Mod	Spa	Spa	Mod	Abs	Spa	Abs	Abs	Mod	Spa
S-23	Irrigation pond near Ester	Hev	Hev	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-24	Roadside ditch near Morgan City	Spa	Spa	Mod	Abs	Spa	Abs	Abs	Abs	Abs	Abs
S-25	Roadside ditch along Hwy 5	Spa	Spa	Mod	Spa	Spa	Mod	Abs	Abs	Mod	Spa

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.



a. Vigorous growth of the aquatic morphotype of alligatorweed in June 1982. Some *Vogtia* damage was present

b. Alligatorweed was severely damaged by *Agasicles* and *Vogtia* in October 1982

Figure 17. Site 36--Shell Bank Bayou (St. John the Baptist Parish), Louisiana

a. An extensive mat of aquatic alligatorweed in June 1982

b. The alligatorweed mat had been greatly reduced by October 1982. *Hydrocotyle* had become dominant and covered the canal

Figure 18. Site 41--Gibson (Terrebone Parish), Louisiana

both morphotypes were observed at the two secondary sites (S-26 and S-17). *Amynothrips*, the only biocontrol agent found, were collected at both the Jackson Sewage Treatment Plant and the catfish ponds (S-17) in D'Lo (Table 8).

47. October. Aquatic alligatorweed had decreased since June at the Jackson Sewage Treatment Plant and the catfish ponds in D'Lo. It was being impacted by *Agasicles* at the Jackson Sewage Treatment Plant and by *Vogtia* at the catfish ponds in D'Lo. The abundance of terrestrial alligatorweed remained unchanged at all sites; however, *Amynothrips* were again collected on this morphotype at the catfish ponds in D'Lo.

North Carolina

48. June. Both terrestrial and aquatic alligatorweed were present at six of the seven primary sites visited (Figures 19a, 20a and 21a). The Chadborn site (51) was the only primary site that had no aquatic alligatorweed. *Vogtia*, the only biocontrol insects present, were found only at Lake Waccamaw (50) (Table 9).

49. October. Terrestrial alligatorweed remained at approximately the same level as was found during the June collection for all primary sites except the Chadborn site, which appeared to have been treated by chemicals. Aquatic alligatorweed increased in abundance at Columbia (Figure 19b) and Wilmington (49) (Figure 21b), decreased at Plymouth (47) (Figure 20b) and Lake Waccamaw, and was stable at the other three sites. *Vogtia* were collected at five of the seven primary sites and appeared to be responsible for the reduction in alligatorweed at Plymouth and Lake Waccamaw. *Agasicles*-type feeding was observed at Plymouth, Wilmington, and Lake Waccamaw; however, no *Agasicles* were collected after extensive examination. *Amynothrips* were not found at any site. A native webworm species was impacting the alligatorweed at three primary sites and one secondary site.

South Carolina

50. June. Terrestrial alligatorweed was present at 7 of the 10 primary sites visited and occurred in greatest abundance at the Savannah National Wildlife Refuge (61) (Figure 22a). The aquatic form of alligatorweed was also widely distributed, being observed at 7 of the 10 primary sites (Figure 23a). Alligatorweed was especially abundant at the Rowesville (53) and Branchville (54) (Figure 24a) sites, both of which are located on the North Fork of the Edisto River. *Vogtia* were the only biocontrol insects collected, and they were found in low numbers at the Branchville site (Table 10).

Table 8

Summary of Plants and Insects Surveyed in Mississippi

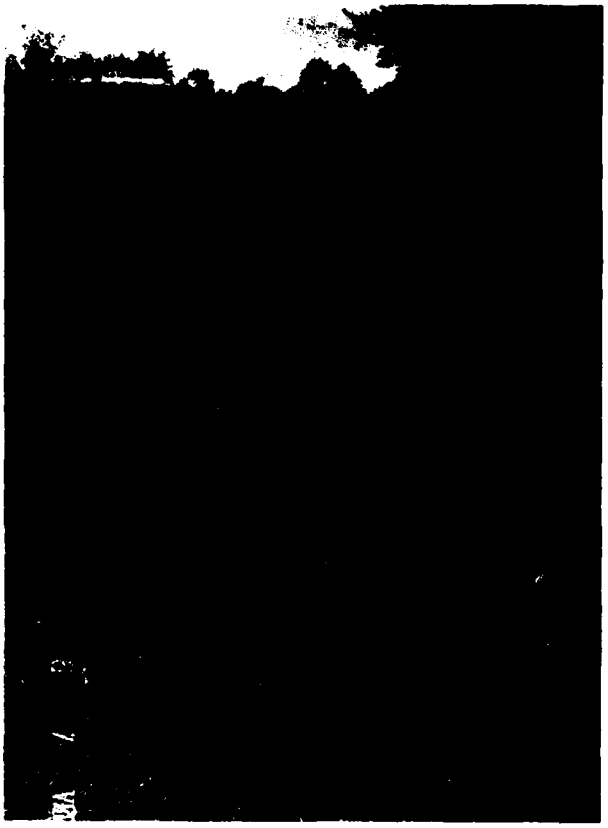
Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
42	Bayou Bogue Phalia (Stoneville)	Abs*	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
43	Jackson Sewage Treatment Plant	Mod	Mod	Spa	Spa	Abs	Mod	Spa	Abs	Abs	Abs
44	Benard Bayou	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-26	Ross Barnett Reservoir	Spa	Spa	Spa	Spa	Abs	Abs	Abs	Abs	Abs	Spa
S-17	Catfish ponds, D'Lo	Spa	Spa	Spa	Mod	Abs	Abs	Spa	Spa	Abs	Mod

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

a. Alligatorweed was present as small fringe vegetation in June 1982

b. By October 1982, alligatorweed had extended from the banks and almost completely covered the site. *Vogtia* were present in October 1982 and produced the brown damaged area at the right of the picture

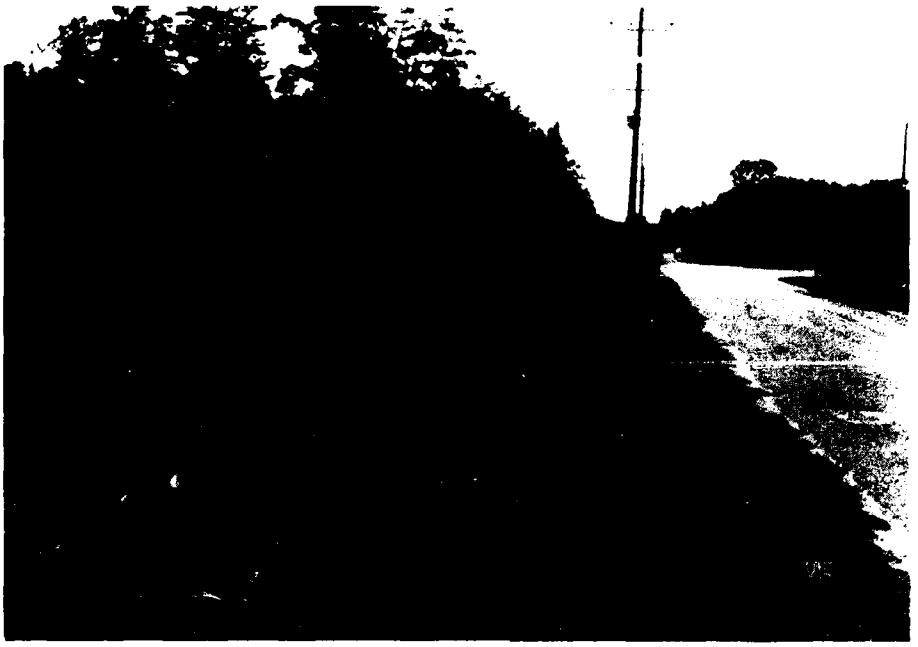
Figure 19. Site 46--Columbia (Tyrrell County), North Carolina



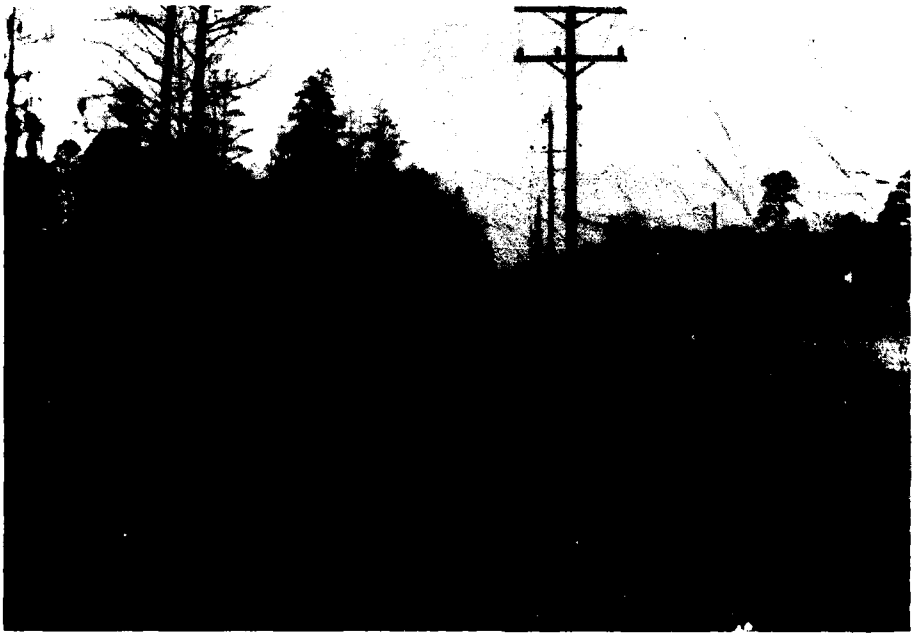
a. Vigorous aquatic alligatorweed was growing out from the bank in June 1982

b. In October 1982, the alligatorweed had extended its growth; however, *Vogtia* were having a major impact on the mat, as can be seen from the brown damaged areas

Figure 20. Site 47--Plymouth (Conaby Creek, Washington County), North Carolina



a. Small clumps of aquatic alligatorweed were present in this roadside canal in June 1982



b. In October 1982, the alligatorweed mat covered the entire canal

Figure 21. Site 49--Wilmington (New Hanover County), North Carolina

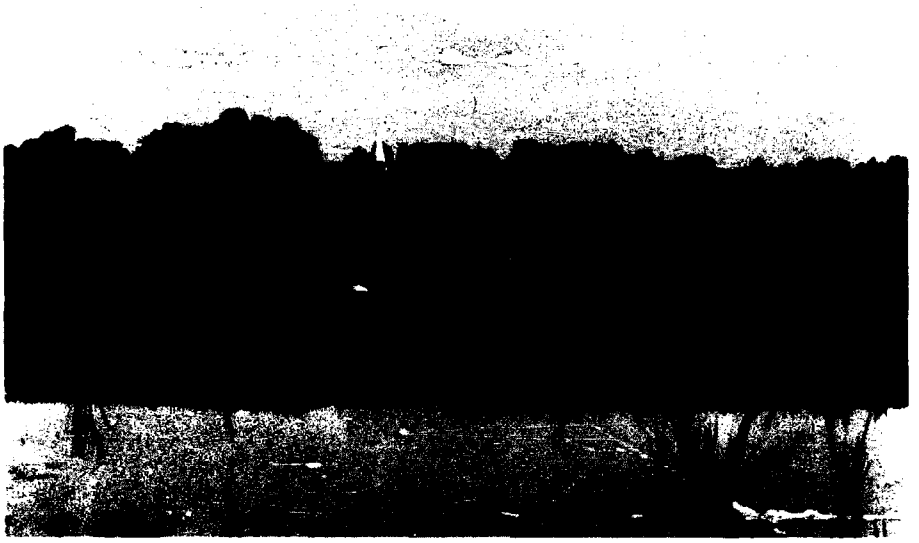
Table 9

Summary of Plants and Insects Surveyed in North Carolina

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
45	Ahoskie	Mod*	Mod	Spa	Spa	Abs	Abs	Abs	Abs	Abs	Spa**
46	Columbia	Spa	Spa	Mod	Hev	Abs	Abs	Abs	Abs	Abs	Hev
47	Plymouth	Spa	Spa	Hev	Hev	Abs	Abs	Abs	Abs	Abs	Mod
48	Greenfield Lake	Spa	Spa	Spa	Spa	Abs	Abs	Abs	Abs	Abs	Abs
49	Wilmington (Battleship North Carolina)	Spa	Spa	Hev	Hev	Abs	Abs	Abs	Abs	Abs	Mod
50	Lake Waccamaw	Spa	Spa	Hev	Mod	Abs	Abs	Abs	Abs	Spa	Mod
51	Chadborn	Mod	Spa	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
S-28	Small farm pond near Kingston	Spa		Spa		Abs		Abs		Abs	
S-29	Kendrick Creek near Roper	Spa	Spa	Mod	Mod	Abs	Abs	Abs	Abs	Abs	Mod
S-30	West side of Scuppernong River near Columbia	Hev	Hev	Spa	Spa	Abs	Abs	Abs	Abs	Abs	Mod
S-31	Queen Anne Creek in Edenton		Spa		Hev		Abs		Abs		Abs

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

** Based on the characteristic feeding pattern of the insect even though no individuals were collected.



a. Terrestrial alligatorweed in Pool 5 during the June 1982 sampling trip

b. Insect damage in October 1982 after water was introduced into the pools

Figure 22. Site 61--Savannah National Refuge (Jasper County), South Carolina (continued)

c. Terrestrial alligatorweed covering most of the levees around the pools

Figure 22. Site 61 (Concluded)

51. October. Terrestrial alligatorweed occurred in the same abundance as it had occurred in June, except at the Savannah National Wildlife Refuge (Figure 22b). Scheduled compartment flooding at the refuge reduced the amount of terrestrial alligatorweed. Reductions in aquatic alligatorweed occurred at Rowesville, Branchville (Figure 24b), and Whitehall (59) (Figure 23b). Alligatorweed at all other sites occurred at the same or slightly increased abundance, except where changing water levels at Savannah River (61) caused a greater increase. Both *Vogtia* and *Agasicles* appeared to contribute to the observed reductions in aquatic alligatorweed. *Amynothrips* were not collected at any site; a native webworm species was also collected at three sites.

Tennessee

52. No alligatorweed or biocontrol insects were found at the only release site reported by Coulson (1977) in Tennessee (Table 11).

Texas

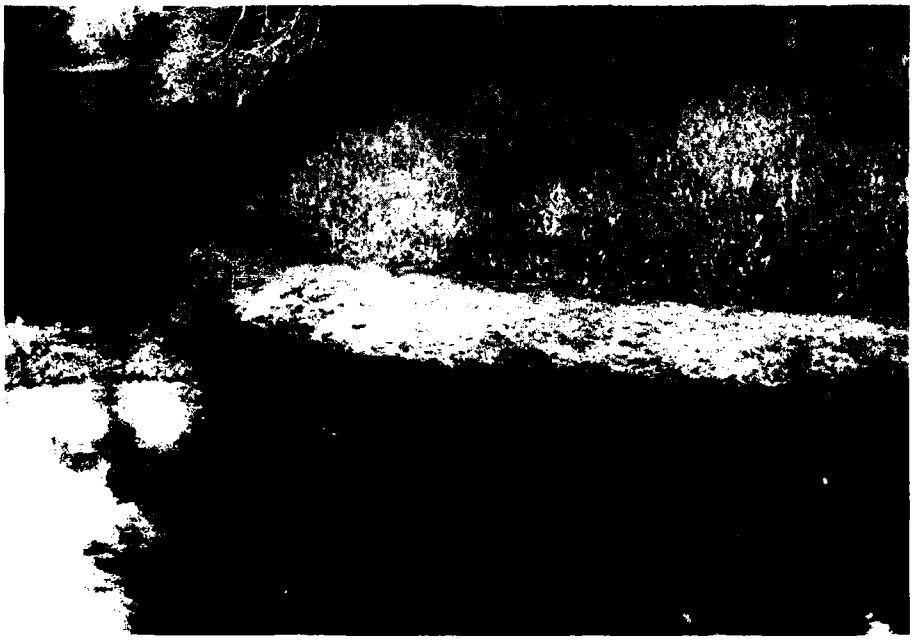
53. June. Terrestrial and aquatic forms of alligatorweed were present at all primary sites except Houston, where the areas were dredged or are now

a. Healthy alligatorweed in June 1982 without insect damage

b. Alligatorweed impacted by insects in October 1982

Figure 23. Site 59--Whitehall (Colleton County), South Carolina

a. An alligatorweed mat extending into the river in June 1982



b. The same alligatorweed mat as it appeared in October 1982. Severe *Vogtia* damage was observed at this site in October

Figure 24. Site 54--Branchville (North Fork of Edisto River, Orangeburg County), South Carolina

Table 10

Summary of Plants and Insects Surveyed in South Carolina

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
52	Low Falls Boat Landing	Abs*	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
53	Rowesville	Spa	Spa	Mod	Spa	Abs	Abs	Abs	Abs	Abs	Spa
54	Branchville	Spa	Spa	Hev	Spa	Abs	Spa	Abs	Abs	Spa	Hev
55	Goose Creek Reservoir	Spa	Spa	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
56	Fairfax	Spa	Spa	Mod	Mod	Abs	Abs	Abs	Abs	Abs	Abs
57	Ashepoo River	Spa	Spa	Spa	Spa	Abs	Spa	Abs	Abs	Abs	Mod
58	Remick Swamp	Abs	Abs	Spa	Abs	Abs	Abs	Abs	Abs	Abs	Abs
59	Whitehall	Spa	Spa	Mod	Spa	Abs	Spa	Abs	Abs	Abs	Abs
60	Coosawhatchie River	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
61	Savannah National Wildlife Refuge	Hev	Mod	Mod	Mod	Abs	Hev	Abs	Abs	Abs	Abs
S-32	Canal North of Ridgeland	Spa	Spa	Hev	Mod	Abs	Mod	Abs	Abs	Abs	Mod

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

Table 11

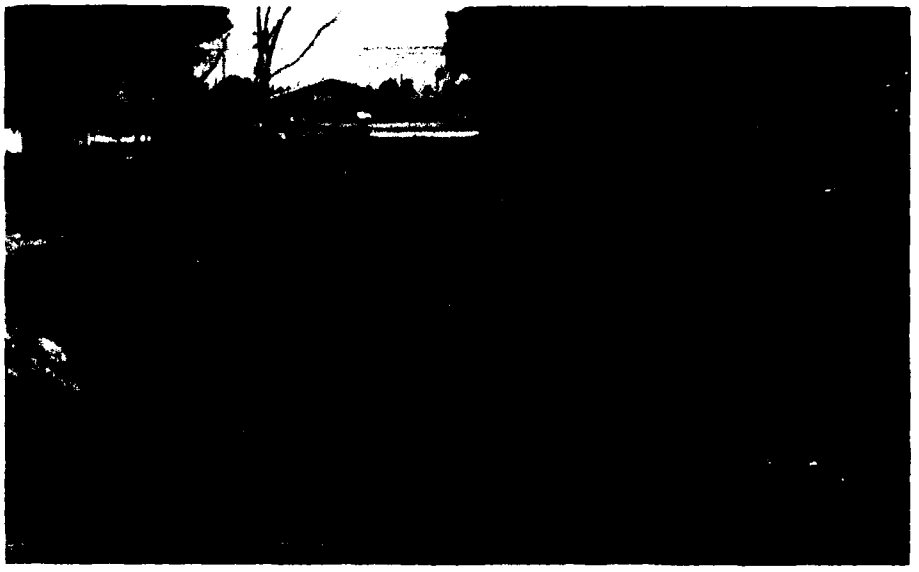
Summary of Plants and Insects Surveyed in Tennessee

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
62	Nickajack Reservoir	Abs*	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs

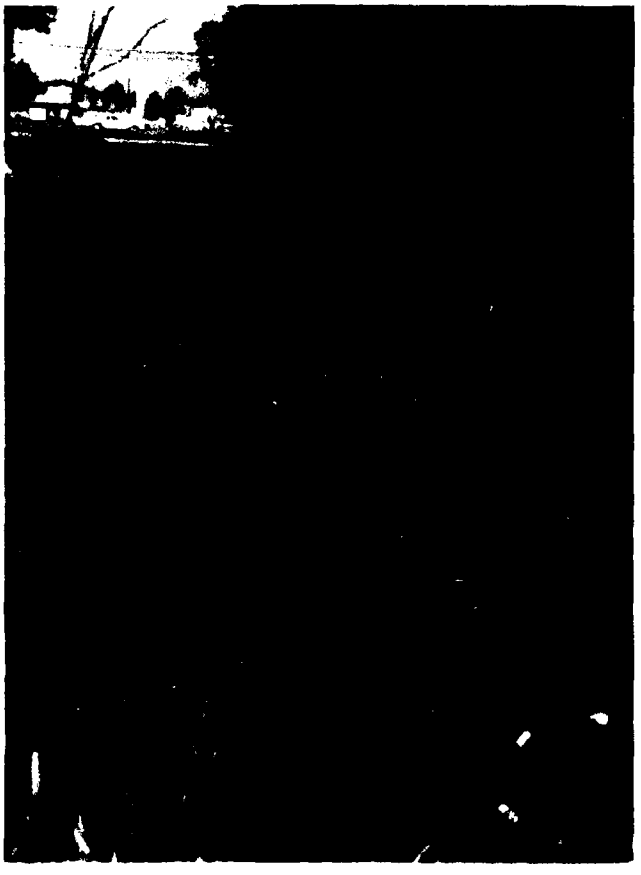
* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

completely concreted. *Agasicles* were collected at three of four sites having alligatorweed, and *Vogtia* were collected at two sites (Figures 25a and 26a). *Amynothrips* were found only at the J. D. Murphree Wildlife Management Area (67), where releases were made in September 1981 (Table 12).

54. October. Overall, no reduction in the terrestrial alligatorweed population was observed. *Amynothrips* were found to impact the terrestrial alligatorweed in a small portion of the J. D. Murphree Wildlife Management Area. Aquatic alligatorweed was severely impacted by *Agasicles* and *Vogtia* at Winnie (64) (Figure 25b), Wallisville (65), and J. D. Murphree Wildlife Management Area (Figure 26b and 26c).



a. A vigorously growing mat of alligatorweed was present in June 1982. *Vogtia* were present in moderate numbers



b. Alligatorweed had been extensively reduced in October 1982

Figure 25. Site 64--Winnie (Chambers County), Texas

a. An extensive mat of alligatorweed in one of the interior canals, June 1982

b. An extensive alligatorweed mat with a small amount of *Vogtia* damage, June 1982

Figure 26. Site 67--J. D. Murphree Wildlife Management Area (Jefferson County), Texas (Continued)

c. An alligatorweed mat severely impacted by *Vogtia* and *Agasicles*, October 1982

Figure 26. Site 67 (Concluded)

Table 12

Summary of Plants and Insects Surveyed in Texas

Site No.	Site Name	Alligatorweed Abundance				Insect Abundance					
		Terrestrial		Aquatic		*Agasicles hygrophila*		*Amynothrips andersoni*		*Vogtia malloi*	
		Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
63	Dam B (Steinhagen Lake)	Mod*	Spa	Mod	Spa	Spa	Mod	Abs	Abs	Abs	Spa
64	Winnie	Spa	Spa	Hev	Spa	Abs	Mod	Abs	Abs	Mod	Spa
65	Wallisville	Mod	Mod	Mod	Abs	Mod	Abs	Abs	Abs	Abs	Abs
66	Houston	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs	Abs
67	J. D. Murphree Wildlife Management Area	Mod	Mod	Hev	Spa	Mod	Mod	Spa	Spa	Hev	Mod
S-33	Roadside ditch near Ragwood	Hev	—**	Abs	—	Abs	—	Abs	—	Abs	—
S-34	Drainage ditch near Winnie	Spa	Spa	Hev	Abs	Abs	Abs	Abs	Abs	Spa	Abs
S-35	Jones Creek near Sugarland	—	Spa	—	Hev	—	Abs	—	Abs	—	ABs

* Abs = absent, Spa = sparse, Mod = moderate, Hev = heavy.

** Not observed.

PART IV: DISCUSSION

55. Since the amount of alligatorweed and the impact of the biocontrol agents on the alligatorweed population vary among geographic regions, this discussion will first address the situation that exists in each state. Afterward, some general trends in the alligatorweed population and impacts of biocontrol agents will be discussed.

States

Alabama

56. Alligatorweed. In 1963, Alabama ranked third in total acreage (4,750 acres) of alligatorweed, with the most severely impacted acres being the Mobile Delta and the southern portions of Mobile and Baldwin Counties. Acreage figures are not being currently compiled on alligatorweed in these areas because biocontrol agents have reduced alligatorweed to a nonproblem level. The northern portion of the state had less than 100 acres of alligatorweed in 1963, primarily in river systems. In 1981, this northern portion had a total infestation of 825 acres.

57. Biocontrol agents. All three biocontrol insects were found in Alabama. However, *Agasicles* and *Amynothrips* had just been released (May 1982) in the Tennessee Valley Authority (TVA) areas about 3 weeks prior to the June sampling trip. *Agasicles* was the most prevalent biocontrol agent found in June, even in the southern portion of the state, where it was not rereleased in 1982. *Amynothrips* were collected in only the northern portion of the state, and *Vogtia* were found at two northern sites (1 and 2) in October. *Vogtia* were never collected at the three southern sites, probably because aquatic alligatorweed had been impacted by *Agasicles* feeding. Sufficient control had been achieved at two of the southern sites (4 and 6) in October (Figure 11) so that almost no aquatic alligatorweed remained. *Agasicles* released in May 1982 significantly reduced the alligatorweed at Steenson Hollow (2) (Figure 10) and Woodlawn Springs (3) by October. Cain Creek (1) was the only northern site that did not have rereleases of *Agasicles* in May 1982, and *Vogtia* appeared to be causing the most damage in October. *Agasicles* and *Amynothrips* were found at Cain Creek; however, their impact was not as extensive as that of *Vogtia*.

58. Management plan. The northern area, which is part of the TVA system, requires an annual rerelease program, because insect biocontrol agents overwinter poorly in northern Alabama. *Agasicles* and *Amynothrips* can be released early in the growing season at sites where alligatorweed occurs at problem levels. Early releases allow the insect populations to develop before the alligatorweed population reaches problem levels. *Vogtia* could possibly be used in this early release program for additional impact. Excellent alligatorweed control has been achieved in some areas. Although the southern portion of the state currently appears to have no alligatorweed problem, periodic monitoring of insect populations is needed.

Arkansas

59. Alligatorweed. In 1963, the alligatorweed infestation in Arkansas was limited to 122 acres in the southeastern portion. Data on the 1981 alligatorweed acreage were unavailable. Alligatorweed mats still occur at many of the original release sites reported by Coulson (1977). Most examined sites had only a small amount of alligatorweed; however, a few areas (e.g., sites 9 and 10) (Figure 12) had a locally serious problem.

60. Biocontrol agents. *Agasicles* were never collected at any site. The *Agasicles*-type damage reported for both the June and October sampling at sites 7 and 10 was probably caused by a native flea beetle (*Disonycha*). *Amynothrips* and *Vogtia* were never released in Arkansas, and no individuals of either species were collected. *Vogtia* and *Agasicles* have been reported by Vogt, Quimby, and Kay (in press) to migrate into Arkansas, but their migration and impact seem to be dependent on seasonal conditions.

61. Management plan. A management plan similar to the TVA plan should be extremely effective in controlling the alligatorweed population.

Florida

62. Alligatorweed. Florida ranked fourth in alligatorweed acreage in 1963 with 2,600 acres. Although alligatorweed occurred throughout the state in 1981, Federal and State agencies indicated that it was not a major problem and reported only a 900-acre infestation. The terrestrial morphotype persisted in areas where *Amynothrips* were absent, and the aquatic morphotype was found largely in areas of new agricultural operations where insects might have been subjected to high pesticide levels. Pesticide impact may reduce the insect-population levels and allow alligatorweed to flourish.

63. Biocontrol agents. All three biocontrol insects were collected in Florida during both trips. The biocontrol agents were providing excellent control of the aquatic morphotype in nearly all areas, (Figures 13, 14, and 15) and *Amynothrips* were impacting the terrestrial morphotype.

64. *Agasicles* were more prevalent early in the growing season throughout most of the state, being found at 11 sites. Abundant *Vogtia* populations were observed in June at four sites south of Fort Pierce. Fewer sites had *Agasicles* or *Vogtia* populations in October, due primarily to the absence of alligatorweed populations at many sites. *Amynothrips* were observed at only one location during each trip.

65. Management plan. Overall, alligatorweed is not a problem in Florida. However, insect populations should be monitored periodically, in case extreme environmental factors cause the insect populations to decline significantly and reduce their impacts on alligatorweed. Should this occur, rereleases may be necessary.

Georgia

66. Alligatorweed. The total acreage of alligatorweed in Georgia was 1,800 acres in 1963, but only 100 acres were reported in 1981. The major alligatorweed problem area in Georgia in 1963 was Jim Woodruff Reservoir (30) (Lake Seminole 300 to 400 acres). In 1982, only small colonies of alligatorweed were found at scattered locations in the lake. Some habitats where alligatorweed previously was dominant are now completely replaced with other plant species. The biocontrol agents have probably provided other aquatic plants a competitive advantage over alligatorweed.

67. Biocontrol agents. *Agasicles* were the only biocontrol agents found in Georgia, but they were collected at all three examined sites. *Agasicles* appear to produce the greatest impact on alligatorweed during midseason in the southern portion of the state. Although *Vogtia* were not found in Georgia, they occurred in three states surrounding Georgia and were found at the Savannah National Wildlife Refuge only 1 mile from the Georgia-South Carolina border. Thus, *Vogtia* populations probably occur on alligatorweed in Georgia.

68. Management plan. Georgia has no major problem areas of alligatorweed, but the insect biocontrol agents should be periodically monitored so that any decline in their populations can be identified and corrected.

Louisiana

69. Alligatorweed. Although Louisiana had the largest reported acreage (169,000 acres) of alligatorweed in 1981, it was not considered to be a major problem. Locally serious problem areas sometimes occur in the southern half of the state. A large portion of alligatorweed in Louisiana is the terrestrial morphotype, which is considered by some to be an important food source for cattle, nutria, and crayfish. The aquatic morphotype recurs annually in many canals and ditches, but biocontrol agents usually limit its rate of population development.

70. Biological agents. Alligatorweed spreads when environmental factors reduce the populations of biocontrol insects. Once the insect populations redevelop, the alligatorweed infestation is reduced. *Agasicles* and *Vogtia* were found at numerous sites during both sampling trips. Insect populations developed earlier in the year at sites in the southern portion of the state (Figure 17). *Amynothrips* was found at the Ruddock Canal site during the June sampling trip. This was unexpected because *Amynothrips* releases were never reported in Louisiana (Coulson 1977), and its ability to disperse is limited. The nearest documented release of *Amynothrips* occurred in Mississippi, approximately 200 miles from the location in Louisiana.

71. Management plan. *Amynothrips* should be further distributed in Louisiana to assist in controlling the terrestrial morphotype of alligatorweed. *Agasicles* and *Vogtia* populations should be periodically monitored, and rereleases should be made in areas where environmental conditions have reduced population levels.

Mississippi

72. Alligatorweed. Alligatorweed occurs at scattered locations in the southern two-thirds of Mississippi. No current records of alligatorweed acreage are available, but only 52 acres were reported statewide in 1963. The most severe problem area in 1982 was a small infestation in Blue Lake near Itta Bena, Miss. Other locally serious problem areas occur in the northern portion of the state, but alligatorweed is not a serious problem in the southern portion of the state.

73. Biocontrol agents. Only *Agasicles* and *Amynothrips* were released in Mississippi, but all three biocontrol agents were observed in 1982. *Agasicles* and *Vogtia* appear to be controlling alligatorweed in the southern portion of the state. State personnel are rereleasing *Agasicles* in the Blue Lake area.

Although *Amynothrips* were present in Mississippi, they were not widely distributed. Populations were found only at Jackson and D'Lo, both of which are south of the original release site in Rankin County.

74. Management plan. Early spring releases of *Agasicles* should be continued in infested areas in the northern portion of the state. *Vogtia* and *Amynothrips* should also be used in the early release program. A monitoring program should be implemented on a periodic basis to evaluate the biocontrol insect populations.

North Carolina

75. Alligatorweed. North Carolina generally represents the northeastern limits of the range of alligatorweed in the United States, although a few plants have been found in Virginia. The total alligatorweed acreage for North Carolina was 372 acres in 1963, but no records are available on current acreage or problem areas. Large problem areas of alligatorweed do not occur in the state, but small, scattered, locally serious problems exist.

76. Biocontrol agents. Only two of the biocontrol agents were released in North Carolina. *Vogtia* populations, which were released in 1971, annually impact the alligatorweed population (Figures 19 and 20). *Agasicles* populations have not developed, although numerous releases have been made since 1967. *Amynothrips* were never released in North Carolina, and this is the only insect biocontrol agent that completes its life cycle on the terrestrial morphotype.

77. Management plan. The inability of *Agasicles* to overwinter and the lack of established populations of *Amynothrips* indicate that management efforts should be intensified to maximize the effectiveness of using biocontrol agents to control alligatorweed. Alligatorweed probably could be controlled by supplementing the insect populations; therefore, an annual release program for *Agasicles*, *Amynothrips*, and *Vogtia* should be developed. These insects should be released early in the growing season at strategically located sites so that they can begin to impact the alligatorweed when its biomass is low.

South Carolina

78. Alligatorweed. Although South Carolina reported the second largest total acreage (30,000 acres) of alligatorweed in 1963 (including 11,000 acres in the Santee Cooper Reservoir system), the 1981 estimate was only 2,000 acres. Only 100 acres of alligatorweed remained in the Santee Cooper

Reservoir in 1981, and reservoir management personnel do not consider alligatorweed to be a problem. The largest acreage of alligatorweed remaining in South Carolina is at the Savannah National Wildlife Refuge, which is managed for waterfowl. Water level fluctuation, used as a management tool, is conducive to development of the terrestrial morphotype. Terrestrial alligatorweed covers all the levees (Figure 22c) and outcompetes most native vegetation. When the water level is lowered in the various compartments, alligatorweed completely dominates the system. Since *Agasicles* and *Vogtia* populations will not develop on the terrestrial morphotype that dominates during low water, extensive stands of this terrestrial form of alligatorweed occur. Once the water level is raised, alligatorweed begins to convert to the aquatic morphotype, and the biological control agents then attack the plants (Figure 22b). However, water levels are usually not raised until late in the growing season; thus, a large amount of the terrestrial morphotype is present, and only a short period remains before the onset of cold weather. These conditions severely limit the impacts produced by the insects.

79. Biological agents. *Agasicles* and *Vogtia* were observed in South Carolina. *Amynothrips* had been released at seven sites in the state, but was not found at six of these sites (the seventh site was not visited). The populations of all biocontrol agents were very low during June, but had increased by October. *Agasicles* were collected at 5 of the 10 sites visited. *Vogtia* were collected at only three locations.

80. Management plan. South Carolina has isolated problem areas of alligatorweed. Management of insect populations in these areas would greatly assist control efforts. The terrestrial morphotype at the Savannah National Wildlife Refuge is the most extensive problem area, and *Amynothrips* should be used in this area.

Tennessee

81. In 1963, the TVA reported that the alligatorweed infestation in Tennessee was scattered; no total acreages were reported. In 1981, TVA indicated that alligatorweed was still present in the state, but they had no serious problem areas. One release of *Agasicles* was made in Tennessee (Moccasin Bend on the Tennessee River) in 1968, but a population did not develop.

Texas

82. Alligatorweed. Texas ranked sixth in the total acreage of alligatorweed in 1963 with 1,200 acres, whereas state officials reported

18,000 acres in 1981. The increased acreage was probably due to low population levels of biocontrol agents. Insects impacting alligatorweed in Texas are subjected to extreme environmental conditions. Alligatorweed is often exposed to terrestrial conditions, but water completely covers the plants at other times. Changing water levels often occur rapidly and usually do not allow sufficient time for the insect populations to develop on the aquatic morphotype.

83. Biocontrol agents. *Agasicles* were present at two sites in June, and two other sites had large *Vogtia* populations (Figures 25 and 26). Both *Agasicles* and *Vogtia* were also found in October. *Amynothrips* were found only at the J. D. Murphree Wildlife Refuge, where they had been released in 1981. Populations of *Agasicles* and *Vogtia* significantly reduced the aquatic morphotype in some areas, but the terrestrial morphotype remained undamaged.

84. Management plan. A program for monitoring and redistribution of the biocontrol agents should be developed for the successful control of alligatorweed in Texas. The biocontrol agents are effective in Texas when they are not limited by adverse environmental conditions.

General

85. Alligatorweed was not a major problem throughout the southeastern states in 1982. Most major problem areas documented in Coulson (1977) have been eliminated, primarily because of the effects of *Agasicles* and *Vogtia*.

86. Water level fluctuations (natural or man-induced) impact biocontrol agent populations both directly and indirectly. Direct impacts occur when flooding eliminates insects or totally inundates the vegetation, precluding its use as a food source. Drought indirectly impacts the insects. Alligatorweed grows as the terrestrial morphotype when dewatered, therefore eliminating the plant as a food source and/or reproductive habitat for *Agasicles* and *Vogtia*. Although *Amynothrips* will feed on the terrestrial morphotype, they are not highly mobile and do not rapidly invade terrestrial alligatorweed populations. Thus, direct applications of *Amynothrips* may be necessary to address specific problem areas.

87. In areas where insect populations are not maintained or do not occur early in the growing season, other management schemes should be developed and employed to control alligatorweed. The geographic ranges of the

biocontrol agents do not coincide exactly with the geographic distribution of alligatorweed. Thus, biocontrol agents should not be expected to provide control of alligatorweed in all areas.

88. After the initial success of *Agasicles* in controlling alligatorweed in South Carolina and Florida, only limited efforts were made to distribute *Amynothrips* and *Vogtia*. Records indicated that *Agasicles* were released in 11 states, *Amynothrips* in 7 states, and *Vogtia* in 5 states. The limited number of states where *Vogtia* were released did not limit distribution of these highly mobile insects; they occurred in 7 of the 10 states surveyed in 1982 and probably occur in 2 other states (Arkansas and Georgia). *Amynothrips*, which are flightless, have a much more limited distribution. They were found in only 5 of the 10 states and were not widely distributed in any state. Increased distribution of *Amynothrips*, the only biocontrol agent that impacts the terrestrial morphotype to a significant degree, may assist in alleviating alligatorweed problems in areas where other species are ineffective.

89. The 1982 distribution of each biocontrol agent varies both among and within states. Both *Agasicles* and *Vogtia* were found in 7 of the 10 states surveyed. *Agasicles* were not found in Arkansas, North Carolina, and Tennessee; and *Vogtia* were not found in Arkansas, Georgia, and Tennessee. Alligatorweed was not found in Tennessee. Vogt, Quimby, and Kay (in press) indicate that *Agasicles* regularly occur in Arkansas, but their population levels must be extremely low since they were not found in the 1982 survey. The presence of *Vogtia* in states north, south, and west of Georgia indicates that this species probably does occur in Georgia, even though it was not collected in the state. *Amynothrips* were found in only Florida, Louisiana, Mississippi, Alabama, and Texas, and their distribution was usually limited within each state. The *Amynothrips* population found in Alabama and Texas was due to recent releases, and no populations were found in other areas of these states. Florida, Louisiana, and Mississippi have established populations of *Amynothrips*; however, the distribution of *Amynothrips* is also somewhat limited in these states.

90. Biological control of aquatic alligatorweed in the southeastern United States has been successful and represents the first effective application of biocontrol technology for the aquatic habitat in the United States. Local aquatic alligatorweed problems still exist; however these problems can be reduced or eliminated by using the management principles outlined in this

report and the US Army Engineer Waterways Experiment Station (WES) Instruction Report A-81-1 (1981). Terrestrial alligatorweed does not pose a severe problem to the operation of waterways; however, the development of terrestrial alligatorweed populations often causes the reestablishment of aquatic alligatorweed problems. It is for this reason that researchers should examine the possibility of introducing a mobile biocontrol agent that could control terrestrial alligatorweed.

PART V: CONCLUSIONS

91. The following are conclusions of this study:

a. Alligatorweed is not a major problem throughout the southeastern United States, even though it has increased by almost 94,000 acres since 1963.

b. The alligatorweed population levels do vary both among and within states.

c. Louisiana, Florida, and Georgia have only minor alligatorweed problems that generally are controlled by the biocontrol insects.

d. Alligatorweed problems in Mississippi and Alabama vary greatly between the northern and southern portions of the state. In the northern areas alligatorweed occurred as locally serious problem levels, whereas southern portions of these states have no alligatorweed problems.

e. Alligatorweed occurs as a minor problem in South Carolina, Arkansas, and Tennessee.

f. Texas and North Carolina also have minor problem levels of alligatorweed; however, certain environmental conditions often make these problems more severe.

g. Extreme temperature and water fluctuations appear to be the two most important environmental factors influencing the effectiveness of the biocontrol agents.

h. The terrestrial morphotype of alligatorweed that develops after dewatering is unacceptable to both *Agasicles* and *Vogtia* as a food source and reproductive habitat; however, the *Amynothrips* is not sufficiently mobile to rapidly inhabit these dewatered areas.

i. *Agasicles* was unable to regularly impact the aquatic morphotype of alligatorweed in the northern limits of its range. This insect was collected in 7 of the 10 states surveyed (Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas).

j. Increased *Vogtia* populations occurred in the northern states late in the season when alligatorweed biomass was greatest. *Vogtia* was collected in 7 of the 10 states surveyed (Alabama, Florida, Louisiana, Mississippi, North Carolina, South Carolina, and Texas.

k. *Amynothrips* was collected in 5 of the 10 states surveyed (Alabama, Florida, Louisiana, Mississippi, and Texas); however, its distribution was limited in all states.

l. Considerations should be given to determine the availability of a mobile biocontrol agent that impacts the terrestrial morphotype of alligatorweed. Dr. George Vogt (1960), who did

the initial studies on alligatorweed biocontrol agents, has indicated that some work has already been conducted in this area.

m. Managers should be aware that these biocontrol agents are tools for controlling alligatorweed, and population levels should be routinely monitored to determine the need for releases of biocontrol agents.

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APPENDIX A: STUDY SITE DESCRIPTIONS AND DATA

1. Site descriptions are presented below. Primary site numbers are keyed to Figure 6 in the text. Vegetation comments for the sites are based on the first trip in June 1982, unless the site was visited only during October 1982.

2. Primary sites were mostly original release sites, or they were in the area of an original release site. Site locations were often not specific (Coulson 1977),* so sampling sites for this study were located in the general area of an original release site. However, some of the primary sites were selected to assist in covering the geographic area or were recommended by State or Federal agencies.

3. Secondary sites included areas where general observations were recorded. Most of these sites were not original insect release sites; however, a few were presented by Coulson (1977).

4. Primary sites are presented first for each state and are numbered 1 through 67. Secondary sites are presented after the primary sites for each state and are numbered S-1 through S-35.

Alabama

Site 1, warmwater discharge pond, Cane Creek (Pickwick Reservoir) near Cherokee (Colbert County).

5. Location/description. This site was located in a small pond approximately 8 miles west of Tuscumbia at the Colbert Steam Plant north of US Highway 72. This pond (approximately 1 ha) was located on the west side of the entrance road for the plant. There was a 0.5-m to 1-m fringe of the aquatic morphotype of alligatorweed around the pond margin. Some of the terrestrial morphotype was also present.

6. June. The alligatorweed present at this site was mostly the aquatic morphotype and extended 0.5 to 1 m from the shore around the entire site. Plants were 30 to 35 cm tall with diameters of 0.5 cm. This healthy alligatorweed was not flowering, and no insect damage was observed.

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* See References at the end of the main text.

7. October. The alligatorweed mat (90 percent aquatic) at this site had increased in size. The mat extended 1 to 2 m from the shore, and plants were 30 to 35 cm tall with diameters of 0.5 cm. *Vogtia* were responsible for most observed damage, but *Amynothrips* were also present on the plants. Some *Agasicles*-type feeding damage was observed, but only larvae were collected. Webworms were also present in low numbers. The insect populations appeared to be just starting to impact the plant population.

Site 2, Steenson
Hollow (Wilson Lake) near
Muscle Shoals (Colbert County)

8. Location/description. This site was a small backwater area (1 ha) at Wilson Lake located off State Highway 133 opposite Shoals Landing, northeast of Muscle Shoals. Alligatorweed was abundant, and the majority of plants was the aquatic morphotype. Large *Typha* stands were located along the shore, and aquatic and terrestrial vegetation was thick around this area.

9. June. Alligatorweed was very abundant throughout the site. Most plants were the aquatic morphotype, were flowering, had hollow stems (0.6 cm in diameter), and were 40 to 50 cm tall. Large alligatorweed mats were present as a fringe (2 m wide by 35 m long) in scattered locations along the shore and as floating mats in the middle of the lake (Figure 10a). This was a site where TVA biologists released 500 adult *Agasicles*. Five adult *Agasicles* were collected in three 10-m sweeps. No *Vogtia* or *Amynothrips* were observed.

10. October. A significant reduction in the amount of alligatorweed population had occurred (Figure 10b), with only a small amount of plant material remaining. The fringe vegetation consisted of approximately 100 stems spread over a large area (2 by 100 m), and the plants extended only 5 cm above the waterline. The same type of damage was observed in floating mats. Two adult *Agasicles* were collected from plant material at a marina across the road from this site. No *Amynothrips* or *Vogtia* were observed. TVA biologists indicated that the alligatorweed population at this site had been reduced over the past 3 years from 75- to 100-percent coverage to 1- to 5-percent coverage as a result of their annual release program.

Site 3, Woodlawn
Springs (Pickwick Reservoir)
near Florence (Lauderdale County)

11. Location/description. This site was located in a backwater area approximately 16 km southwest of Florence. The site is on the north side of Pickwick Reservoir, and the power plant (1) was observed to the southwest. The water level was relatively low and did not exceed 1 m in the area where alligatorweed was present. A fringe mat of the aquatic morphotype occurred on both sides of the slough. Some of the terrestrial morphotype was also present.

12. June. Ninety percent of the plants at this site were the aquatic morphotype. Plants were flowering, had hollow stems, and were 25 to 30 cm tall. Mats were present for at least 1 mile up- and downriver from the release site. Since this was a recent release site, no attempts were made to collect *Agasicles*. However, 27 adult *Agasicles* were observed on the plants in a 3.5- by 20-m area. A population of *Amynothrips* was found at this location. They were probably accidentally introduced with the *Agasicles*. *Amynothrips* had been released in 1969 upstream in Collier's Slough, along with *Agasicles*.

13. October. Plants were severely impacted in both the aquatic and terrestrial habitats. There appeared to be a 30- to 40-percent reduction of alligatorweed in the immediate area, with the largest reduction occurring in the aquatic morphotype. Plants were still 25 to 30 cm tall, but most were completely defoliated. *Agasicles* collected at this site appeared to be causing the most impact. *Amynothrips* and *Vogtia* were also present in fairly large numbers, but they appeared to be concentrated in particular areas. TVA biologists indicated that they had found *Agasicles* and *Amynothrips* 4 miles up- and downriver from this release site in September 1982.

Site 4, Bolton Branch near
Navco and Mobile (Mobile County)

14. Location/description. This site was located west of the junction of US Highway 90 and Interstate-65 where Highway 90 crosses Bolton Branch. Extending from the Highway 90 Bridge north, the stream had concrete sides and a sparse amount of the aquatic morphotype of alligatorweed. A weir was located at the end of the concrete, and a moderate amount of aquatic morphotype was observed around this structure. North of the weir and extending 300

to 400 m, a fringe of the aquatic morphotype was present, and small amounts of terrestrial alligatorweed were observed along the bank.

15. June. A moderate population of alligatorweed was observed at this site, where a number of alligatorweed mats (0.5 to 1 m) extended from the shore north of the weir (Figure 11a) for 300 to 400 m. Plants were mostly the aquatic morphotype, 25 to 30 cm tall, and healthy. *Agasicles* were impacting the plants, and four adults were collected. No *Vogtia* or *Amynothrips* were collected.

16. October. Only five stems (defoliated) of the aquatic morphotype were found at the site (Figure 11b). The alligatorweed mats extending from the shore in June were completely gone, and only a small amount of the terrestrial morphotype was observed. No insects were found on the small amount of plant material present.

Site 5 drainage ditch
in Foley (Baldwin County)

17. Location/description. This site was located in a drainage ditch on the east side of Alabama Highway 59 near the airport turnoff in Foley. The terrestrial morphotype occurred in a dense mat for approximately 200 m along the drainage ditch. Alligatorweed was also observed in other ditches and canals in the Foley area.

18. June. A population of alligatorweed was found in a drainage ditch (200 m long by 2 m wide) adjacent to Alabama Highway 59. All plants were the terrestrial morphotype and were 15 to 20 cm tall. Plant stems were thick and almost solid (0.3 cm diam). No insect damage or insects were found on any plants.

19. October. Alligatorweed in this drainage ditch was still of the terrestrial morphotype. Plants were healthy and had increased in height (35 to 40 cm). The only insect damage observed was caused by webworms attacking the apical portion of the plants. No *Vogtia*, *Amynothrips*, or *Agasicles* were found.

Site 6, stream connecting Little
Lagoon and Shelby Lake, Gulf Shores
State Park, Gulf Shore (Baldwin County)

20. Location/description. The site was located within Gulf Shores State Park where Alabama Highway 135 crosses the stream connecting Little Lagoon and Shelby Lake. Clumps of the aquatic morphotype of alligatorweed

were found in four locations. These plants appeared healthy. Terrestrial alligatorweed was observed along the bank; however, it was not very extensive.

21. June. Four mats (3 by 6 m) of aquatic alligatorweed were present at this site. Plants were 20 to 30 cm tall and healthy. Park personnel indicated that alligatorweed had been a severe problem in this stream 5 to 6 years earlier. Damage from *Agasicles* was observed, and adults were collected. No *Vogtia* or *Amynothrips* were collected.

22. October. Aquatic alligatorweed plants were severely damaged, and only a few stems of the mats observed in June remained. Plants were only 5 to 10 cm tall and had diameters of 0.4 cm; they appeared to be regrowth. No *Agasicles, Vogtia*, or *Amynothrips* were collected, but webworms were found on a few stems of the terrestrial alligatorweed.

Site S-1, three locations on
Guntersville Lake (Jackson County)

23. Location/description. These sites were all located in Guntersville Lake at three points where US Highway 72 crosses coves of the lake. Two of these areas, Crow and Mud creeks, had a 1 to 1.5-m fringe of the aquatic morphotype, whereas a backwater area near Scottsboro had small mats of floating alligatorweed distributed throughout the area.

24. June-October. These locations all had healthy mats of alligatorweed. In June 1984, Crow and Mud creeks still had a 1- to 1.5-m fringe of the aquatic morphotype, but the number of small floating mats had increased at the backwater area (from North Sauty Creek) west of Scottsboro. An increase in the alligatorweed infestation was noted during October 1982; however, it was not extensive. No insect damage was observed at any of the sites on either sampling trip.

Arkansas

Site 7, Bayou Bartholomew south
of Pine Bluff (Jefferson County)

25. Location/description. This site was located at the point where US Highway 79 crosses Bayou Bartholomew. Both morphotypes of alligatorweed were present. The aquatic morphotype occurred as a 1- to 1.5-m fringe on both sides of the bayou, and the terrestrial morphotype extended approximately 10 m along the bank.

26. June. Both alligatorweed morphotypes were present on the west side of the bridge. Alligatorweed extended 10 m upstream and 1 m from the shore. Plants were healthy, 10 to 15 cm tall, and 0.3 cm in diameter. A small amount of *Agasicles*-type feeding damage was observed, but no adults or larvae were collected. The alligatorweed mat on the east side of the bridge was very small (0.5 by 1 m), and no feeding damage was observed. No *Vogtia* or *Amynothrips* were observed on either side of the bridge.

27. October. Alligatorweed still covered the same general area. Plants appeared healthy, were 25 to 30 cm tall, and had stem diameters of 0.5 mm. *Agasicles*-type feeding damage was again noted throughout the site, but no adults or larvae could be collected from the vegetation. No *Vogtia* or *Amynothrips* were observed throughout this site.

Site 8, Bayou Meto near Gillett (Arkansas County)

28. Location/description. This site was located on Bayou Meto west of Gillett on Arkansas Highway 144 at a water-control structure near the Bayou Meto State Park. A small colony of the aquatic morphotype was found at the base of the control structure.

29. June. The only alligatorweed observed at this site was a small 3- by 3-m mat at the base of the water-control structure. No insects or insect damage was found. Plants were healthy, were 30 to 35 cm tall, and had stem diameters of 0.4 cm.

30. October. The water-control structure was open, and water was flowing rapidly in this area. No alligatorweed was present at the base of the structure.

Site 9, Moody Old River (Arkansas County)

31. Location/description. This site was an oxbow (Moody Old River) about 2 miles east of the Arkansas River on US Highway 165 (also State Highway 1). This oxbow was divided by the highway, and alligatorweed occurred on both sides. The east side had a 3- to 5-m fringe of the aquatic morphotype of alligatorweed extending around the entire impoundment (100 by 500 m). The west side was a smaller impoundment, and alligatorweed was distributed throughout and was not restricted to the fringe.

32. June. A large mat of alligatorweed on the east side of the road extended 3 to 5 m from the shore (total area 500 by 100 m). Smaller mats were

distributed throughout the entire area (Figure 12a). Alligatorweed on the west side of the road was not restricted to the fringe and generally extended from shore to shore (150 by 75 m). Plants had no insect damage and appeared healthy; they were 20 to 25 cm tall and had stem diameters of 0.2 to 0.3 cm. No *Agasicles*, *Vogtia*, or *Amynothrips* were found.

33. October. The alligatorweed mats were approximately the same size as in June (Figure 12b). Plants appeared healthy, but were shorter (5 to 10 cm), and had diameters of 0.3 to 0.4 cm. No *Vogtia*, *Agasicles*, or *Amynothrips* were found, but webworms were present in low numbers.

Site 10, Lucas Pond in
Crossett (Ashley County)

34. Location/description. This lake was located within the city limits of Crossett, Ark. The site was on the northern edge of Lucas Pond (4 ha) off Florida Street. There was a 2- to 3-m fringe of the aquatic morphotype around the lake, and the northern end was completely covered by a vigorously growing mat.

35. June. A 2 to 3-m fringe of aquatic alligatorweed extended around the entire lake (4 ha), and a sparse amount of terrestrial alligatorweed was observed. Plants were flowering, appeared healthy, were 30 to 40 cm tall, and had stem diameters of 0.6 cm. One small area (2 by 3 m) of *Agasicles*-type feeding damage was observed near the shore, but no adults or larvae were observed. No *Vogtia* or *Amynothrips* were found.

36. October. A dense fringe (3 m) of aquatic alligatorweed still existed around the entire lake. Plant height was reduced to 20 cm, and stem diameters were 0.5 cm. The plants appeared healthy and were not damaged by *Vogtia*, *Agasicles*, or *Amynothrips*. Webworms were found in the apical portion of some plants, but the population appeared to be causing only minimal damage.

Site S-2, Bayou Bartholomew
west of Pine Bluff (Jefferson County)

37. Location/description. This site was located at the point where Arkansas Highway 104 crosses Bayou Bartholomew west of Pine Bluff near the Arkansas Boys' Training School. No alligatorweed was present. Coulson (1977) had indicated that a release was made in Bayou Bartholomew west of Pine Bluff; however, the specific location was not indicated.

38. June-October. Alligatorweed was never found at this location on either sampling trip.

Site S-3, Bayou Bartholomew
south of Pine Bluff (Jefferson County)

39. Location/description. This site was located south of Pine Bluff where Arkansas Highway 15 crosses-Bayou Bartholomew. The bayou was covered by a dense mat of the aquatic morphotype (5 by 20 m).

40. October. This site was visited in October 1982, and a dense mat of the aquatic morphotype of alligatorweed was present. Plants appeared very healthy, and no insect damage was observed.

Site S-4, Egg Lake near
Pine Bluff (Jefferson County)

41. Location/description. This site was located in Egg Lake just south of the city limits of Pine Bluff and east of Arkansas Highway 15. A 3- to 6-m fringe of aquatic vegetation occurred around the lake. The vegetation was composed of the aquatic morphotype of alligatorweed, *Polygonum* spp., and *Ludwigia* spp.

42. October. In October 1982, a 3- to 6-m fringe of aquatic plants surrounded the lake with the three dominant species being *Polygonum* spp., *Ludwigia* spp., and the aquatic morphotype of alligatorweed. No insect damage was observed on the alligatorweed during this trip.

Site S-5, roadside ditch along
Arkansas Highway 35 (Drew County)

43. Location/description. This site was located in a roadside ditch along Arkansas Highway 35 just west of its intersection with Arkansas Highway 133. A mat of terrestrial alligatorweed was observed for approximately 100 m.

44. June-October. The mat of the terrestrial morphotype of alligatorweed was present in the ditch during both collecting trips (June and October 1982). No insect damage was ever observed on these plants.

Site S-6, roadside ditch
near Strong (Union County)

45. Location/description. This site was located in a roadside ditch east of Strong, Ark., parallel to US Highway 82. A small infestation of the terrestrial morphotype of alligatorweed was present and extended 30 to 60 m along the highway.

46. June. In June 1984, the terrestrial morphotype of alligatorweed was observed in this ditch paralleling the highway; however, no insect damage was found.

Florida

Site 11, Bayou Chico near Pensacola (Escambia County)

47. Location/description. This site was located in the portion of Bayou Chico north of Navy Boulevard that parallels Idlewood Drive. The bayou had 3- to 5-m fringes of alligatorweed on both sides. This alligatorweed was predominantly the aquatic morphotype.

48. June. A moderate amount of alligatorweed was present. The aquatic morphotype predominated (70 percent). Plants extended 3 to 5 m from the shore at various locations. The largest plants were 30 to 40 cm tall and had diameters of 0.6 cm. Plants appeared healthy, except in three areas (each approximately 0.5 by 1 m) near the shore. These areas had *Agasicles*-type feeding, but only one adult *Agasicles* was found. No other insects or insect damage was observed.

49. October. Portions of the alligatorweed mat were severely impacted. Plants were 25 to 30 cm tall with diameters of 0.5 cm. More than 50 percent of the aquatic alligatorweed was defoliated, but a large amount of underwater biomass still remained. Mainly *Agasicles* larvae were observed.

Site 12, small lake in Blountstown (Calhoun County)

50. Location/description. This site was located within the Blountstown city limits where Florida Highway 20 crosses the lake adjacent to the Blountstown Police Department. There was an extensive fringe of alligatorweed along the lake margin on both sides of Highway 20; this fringe extended nearly across the lake in some places. Most plants were the aquatic morphotype.

51. June. The entire south side of the lake had a fringe of alligatorweed extending 5 to 6 m from the shore (Figure 13a). The alligatorweed mat on the north side of the road extended from the bank about 3 m, but the mat completely covered the entire lake 100 yd north of this road. The majority (90 to 95 percent) of alligatorweed was the aquatic morphotype. Plants were

20 to 30 cm tall and had stem diameters of approximately 0.4 cm. No insect damage was found at this site.

52. October. The aquatic morphotype of alligatorweed was severely impacted (Figure 13b). Plants were small (10 cm) and were 0.4 cm in diameter. Only scattered, small, defoliated stems remained. The damage appeared to be caused by *Agasicles*, but no adults were observed. Only two larvae were collected. Insect damage caused by *Vogtia* or *Amynothrips* was not observed on the small amount of alligatorweed that was still present.

Site 13, inlet on Ortega
River at Timuquana Bridge
near Jacksonville (Duval County)

53. Location/description. This site was located where the Timuquana Road crosses the Ortega River. Alligatorweed, primarily the aquatic morphotype, occurred in a 12- by 60-m area on the northeast side of the bridge. This was the site of the first field release of *Agasicles* in Florida.

54. June. An alligatorweed mat (12 by 60 m) on the northeast side of the bridge was severely impacted by insects (Figure 15a). Plants were 5 cm tall, but they had stem diameters of 1.5 cm. Both *Vogtia* and *Agasicles* were found, and *Amynothrips* were also collected from terrestrial alligatorweed.

55. October. Generally, there was an absence of the aquatic morphotype of alligatorweed, with only 30 to 40 defoliated stems remaining from the large mat present in June (Figure 15b). Plants were 20 cm tall and had stem diameters of 0.5 cm. *Agasicles* and *Amynothrips* were collected, but no *Vogtia* were found.

Site 14, creek south of
Jacksonville (Duval County)

56. Location/description. This site was located in a small creek that passed under US Highway 21 south of Cedar Creek. The aquatic morphotype was abundant, but the terrestrial morphotype also occurred as a fringe along the creek.

57. June. A moderate amount of alligatorweed was present i this small creek. Plants were present 12 to 15 m downstream and extended 0.5 m from the shore on both sides. Plant height was approximately 25 to 30 cm, with diameters of 0.6 cm. Ninety percent of the plants were the aquatic morphotype, and these were severely impacted by *Agasicles*. Fifteen adult and larval

Agasicles were collected, along with two *Vogtia* larvae. No *Amynothrips* were observed.

58. October. No aquatic alligatorweed was found; however, a small amount (0.5 by 1 m) of the terrestrial morphotype was found about 10 m from the bank. No biocontrol insects were collected.

Site 15, Lake Alice, University of Florida, Gainesville (Alachua County)

59. Location/description. This site was located at the last access point to Lake Alice off Museum Avenue, near the agricultural fields on the university campus. Both morphotypes were present. Terrestrial alligatorweed was found 3 to 5 m from the edge of the water, with the aquatic morphotype extending into the lake at numerous locations along the bank.

60. June. Both morphotypes of alligatorweed were present, but the aquatic morphotype was more prevalent (70 percent). Plants of both morphotypes were rather small (15 to 20 cm tall) and had a maximum stem diameter of 0.4 cm. The aquatic morphotype was severely impacted by *Agasicles*, and many stems were completely defoliated (Figure 14a). Six *Agasicles* adults were collected with a sweep net, but no *Vogtia* or *Amynothrips* were observed.

61. October. None of the aquatic morphotype was observed (Figure 14b), and the terrestrial morphotype appeared to be less abundant. Part of the area where the terrestrial morphotype was located had been mowed. No *Vogtia*, *Agasicles*, or *Amynothrips* were observed.

Site 16, Gainesville (Winn Dixie) (Alachua County)

62. Location/description. This site was located along the small stream adjacent to the Winn Dixie store on West University Avenue. The aquatic morphotype of alligatorweed was present as a fringe along the stream (30 m). In certain areas, the mat extended and covered (2 m) the entire stream.

63. June. The aquatic morphotype of alligatorweed was present along the fringe of this small stream and extended completely across in some areas. Plants were healthy, having a height of 40 cm and stem diameters of 0.5 cm. None of the terrestrial morphotype of alligatorweed was found. No insect damage was observed at this site.

64. October. The aquatic morphotype of alligatorweed was present; however, the area that it covered was reduced by 75 percent. Plants were 15 to 20 cm tall and had stem diameters of 0.3 cm. Both *Vogtia* and *Agasicles*

were collected from the alligatorweed. None of the plants exhibited the characteristics of the terrestrial morphotype of alligatorweed.

Site 17, Cross Creek between Orange Lake and Lochloosa Lake (Alachua County)

65. Location/description. This site was located at the point where Florida Highway 325 intersects Cross Creek between Orange and Lochloosa lakes. No alligatorweed was observed in the creek channel, but small clumps of both morphotypes of alligatorweed were present in backwater areas.

66. June. Only a small amount of alligatorweed was found in a backwater area of Cross Creek. Plants were dispersed over 10 to 15 m, but did not form a dense mat. Most (90 percent) was the aquatic morphotype, was small (15 to 20 cm tall), and had stem diameters of 0.3 cm. *Agasicles* feeding was intense on the aquatic morphotype. Collections consisted of four adult and two larvae *Agasicles*, but no *Vogtia* or *Amynothrips* were observed.

67. October. The aquatic morphotype was absent, and only a small amount of the terrestrial morphotype was present. No insects were observed.

Site 18, Deep Creek near Hastings (St. Johns County)

68. Location/description. This site was located northeast of Hastings on County Road 207. The site had a small mat (1 by 4 m) of the terrestrial morphotype on the northwest side of the creek. No alligatorweed was observed on the south side of County Road 207.

69. June. A small mat (1 by 4 m) of alligatorweed was located on the northwest side of the bridge. The water level at this site appeared to be higher than normal. Plants may have been in a terrestrial habitat until the last few days of localized flooding. Plants exhibited characteristics of the terrestrial morphotype. Plants were 10 to 15 cm tall and had stem diameters of 0.4 cm, with stems being almost solid. No insect damage was observed.

70. October. The alligatorweed population on the northwest side of the bridge had increased, and many stems exhibited the aquatic characteristics. This mat was mixed with other aquatic vegetation, but plants were observed in a 3- by 25-m area. Plants were 20 to 30 cm tall and had stem diameters of 0.5 cm. Little feeding damage was observed. A small amount of alligatorweed (20 stems) was present on the southeast side of the bridge. This area had been underwater in June. Plants were 15 to 20 cm tall and had diameters of

0.3 cm. Three *Agasicles* larvae were collected from the 20 stems. No *Vogtia* or *Amynothrips* were observed.

Site 19, Withlacoochee River
near Dunnellon (Marion County)

71. Location/description. This site was located at the Dunnellon city boat ramp on the Withlacoochee River off Florida State Road 41. No alligatorweed was present.

72. June-October. No alligatorweed was found at this site, even though the river was examined for a distance of 200 m on both sides of the city boat ramp.

Site 20, Withlacoochee River
near Rutland (Citrus County)

73. Location/description. This study site was located at the point where Florida Highway 44 crosses the Withlacoochee River. A 3- to 5-m fringe of alligatorweed extended along both sides of the river. Both morphotypes were present.

74. June. A large amount of alligatorweed (12 ha) was present, mostly as a 3- to 5-m fringe. The aquatic morphotype of alligatorweed was dominant (80 percent), having heights of 30 to 35 cm and stem diameters of 0.5 cm. Intense *Agasicles* feeding was observed on the aquatic morphotype, and seven adults were collected. No *Vogtia* or *Amynothrips* were observed.

75. October. A complete absence of the aquatic morphotype of alligatorweed was observed. A small amount of the terrestrial morphotype was found. No insects were found.

Site 21, Lake Monroe near
Enterprise (Volusia County)

76. Location/description. The north shore of Lake Monroe east of Interstate 4 was examined for 5 miles at several locations (i.e., Enterprise Kindergarten). No alligatorweed was present.

77. June-October. No alligatorweed was found on either collecting trip. During both trips, waterhyacinth was observed along this shore.

Site 22, Hillsborough River
near Tampa (Hillsborough County)

78. Location/description. This study site was located on the Hillsborough River immediately downstream from the dam in Rowlett Park.

Alligatorweed was present along the stream margins and in floating mats. Plants were predominantly the aquatic morphotype.

79. June. A 1- to 2-m fringe of alligatorweed was present on the Hillsborough River for 500 m downriver from the dam. Floating alligatorweed mats were also distributed throughout the river. Plants were 30 to 35 cm tall and had diameters of approximately 0.4 cm. A small amount of *Agasicles* feeding was observed, and one adult *Agasicles* was collected. No *Vogtia* or *Amynothrips* were found.

80. October. A 2-m fringe of the aquatic morphotype of alligatorweed was still present, and some floating mats were observed. Plants were 30 to 40 cm tall and had stem diameters of 0.6 cm. Terrestrial alligatorweed was also present in small clumps and had no damage. The aquatic alligatorweed mat was being severely impacted by *Agasicles*. More than 50 adult *Agasicles* and numerous larvae were collected. No *Vogtia* or *Amynothrips* damage or individuals were observed.

Site 23, Header Canal,
Fort Pierce (St. Lucie County)

81. Location/description. The study site was located 9 km west of the Fort Pierce exit from the Florida Turnpike, where Florida Highway 70 crosses Header Canal. Alligatorweed occurred as a fringe (0.5 by 50 m) on the east side of the canal and under the highway bridge. Plants were 30 to 40 cm in height and were predominantly the aquatic morphotype.

82. June. A sparse to moderate amount of alligatorweed was present in the canal, mainly north of Florida State Highway 70, and on the east side of the canal. Plants were 30 to 40 cm tall and had stem diameters of 0.5 cm. Aquatic alligatorweed was the predominant form. Intense *Agasicles* damage was observed, along with some *Vogtia* damage on the aquatic morphotype. No *Amynothrips* were observed.

83. October. Both morphotypes of alligatorweed were present during October. The terrestrial morphotype had the same population density, but the aquatic morphotype was reduced slightly. Plants were 30 cm tall and had stem diameters of approximately 0.7 cm. *Agasicles* adults and webworm larvae were collected from the mat, but neither appeared to be severely impacting the plants. No *Vogtia* or *Amynothrips* were observed.

Site 24 canal at
Moore Haven (Glades County)

84. Location/description. This site was located in a canal within the city limits of Moore Haven adjacent to the B&B Supermarket. A 5 by 7-m mat of alligatorweed was present in the canal. Plants were primarily the aquatic morphotype.

85. June. The alligatorweed mat was rather small (5 by 7 m). Plants were mostly the aquatic morphotype, were approximately 35 cm tall, and had stem diameters of 0.6 cm. Intense *Agasicles* feeding, along with a sparse amount of *Vogtia* damage, was observed. Six adult *Agasicles* and one *Vogtia* larva were collected.

86. October. Alligatorweed was not present at the site, although numerous other aquatic plants were present. None of the biocontrol insects were collected.

Site 25, canal at
Clewiston (Hendry County)

87. Location/description. This site was located in a canal between US Highway 27 and the US Army Engineer District, Jacksonville, Clewiston Area Office. Only a small mat of the aquatic morphotype was present.

88. June. Only a few small mats (0.5 by 2 m) of alligatorweed were observed. Plants were exclusively the aquatic morphotype, ranging from 35 to 40 cm tall with stem diameters of 0.6 cm. *Agasicles* adults and *Vogtia* larvae were collected from the mats. Plants were damaged, but not severely. No *Amynothrips* were observed.

89. October. Although the small aquatic alligatorweed mats observed in June were not present, aquatic alligatorweed was observed in different areas at the marina. Plants were 20 cm tall and had diameters of 0.5 cm. Submerged alligatorweed in these new mats had a diameter of 1.2 cm. Intense *Agasicles* feeding was observed on the emergent vegetation, and stems were defoliated. Adult and larval *Agasicles* were collected (50 individuals), but no *Vogtia* or *Amynothrips* were found.

Site 26, roadside canals near
Delray Beach (Palm Beach County)

90. Location/description. Several roadside ditches and canals in and around Delray Beach were examined, since no exact location was given by Coulson (1977). No alligatorweed was present in any of the areas examined.

91. June-October. No alligatorweed was found in any of the drainage ditches or canals. Many drainage ditches appeared to have been treated with herbicides.

Site 27, pit canal near
Fort Lauderdale (Broward County)

92. Location/description. This site was located on the south side of Florida Highway 44 (Sunrise Boulevard). USDA personnel from the Fort Lauderdale Aquatic Weed Research Laboratory indicated that this had been one of the release sites for *Agasicles*. Alligatorweed was present on both sides of the canal as a fringe growth. The majority of alligatorweed was the aquatic morphotype.

93. June. A 1- to 2-m fringe of mostly the aquatic morphotype was present along 1.6 km of the canal. Terrestrial alligatorweed was found along the bank. Plants were flowering, having heights of 35 to 40 cm and stem diameters of 0.6 cm. *Agasicles* feeding was very abundant, along with some *Vogtia* damage. Seven adult *Agasicles* and three *Vogtia* larvae were collected. No *Amynothrips* were observed.

94. October. The aquatic morphotype of alligatorweed was still abundant. Plants were 30 to 35 cm tall and had stem diameters of 1.0 cm. The fringe of alligatorweed extended 2 to 3 m from the shore. *Vogtia* larvae (six individuals) and webworms were collected from the mat. No *Agasicles* or *Amynothrips* or their damage was observed.

Site S-7, Appalachicola River
near Blountstown (Calhoun County)

95. Location/description. This site was located at the point where Florida Highway 20 crosses the Appalachicola River east of Blountstown. The river bank area was examined from the west side. No alligatorweed was present.

96. June-October. Alligatorweed was never found at this site on either sampling trip.

Site S-8, drainage ditch north
of Blountstown (Calhoun County)

97. Location/description. This site was located in a drainage ditch that crosses Florida Highway 69 north of Blountstown, immediately south of the Jackson County line. A small mat (3 by 6 m) of the terrestrial morphotype was present.

98. June-October. A small mat (3 by 6 m) of the terrestrial morphotype of alligatorweed was present. No insect damage was observed in June 1982; however, in October 1982, the majority of alligatorweed was absent, and only a few stems remained.

Site S-9, Black Creek
near Russell (Clay County)

99. Location/description. This site was located at the point where US Highway 17 crossed Black Creek south of Jacksonville. The aquatic morphotype occurred as a floating mat near the Black Creek Marina. Both morphotypes were present on the southeast side of the highway.

100. October. In October 1982, both the aquatic and terrestrial morphotypes of alligatorweed were present at this site. The floating alligatorweed mats had a sparse amount of damage from *Vogtia* and *Agasicles*. The terrestrial morphotype appeared healthy and exhibited no insect damage.

Site S-10, drainage ditches
near Green Cove Springs (Clay County)

101. Location/description. This site was located in drainage ditches along US Highway 17 south of Green Cove Springs. The terrestrial morphotype of alligatorweed was found throughout these ditches.

102. October. Thick mats of the terrestrial morphotype of alligatorweed were observed at this site in October 1984. Continuous alligatorweed mats extended 1 to 2 km. No insect damage was observed on any of the vegetation.

Site S-11, drainage ditches
near Hastings (St. Johns County)

103. Location/description. This site was located along Florida Highway 13 1 to 2 km southeast of Hastings. Large quantities of the terrestrial morphotype occurred in ditches on the south side of the highway.

104. October. In October 1982, this site had the terrestrial morphotype of alligatorweed, and mats (1 m wide) extended 100 to 200 m. Plants were healthy and had no insect damage.

Site S-12, roadside ditch
near Spuds (St. Johns County)

105. Location/description. This site was located in a roadside ditch, half a mile east of Spuds on the north side of Florida Highway 206. The ditch

(1 m wide) was covered by a mat of the terrestrial morphotype, which extended 60 to 70 m along road.

106. June-October. The terrestrial morphotype of alligatorweed was present in this ditch in June 1982, and the plants appeared healthy, without any insect damage. In October 1982, the plants had increased in height and coverage, but no insect damage was observed.

Site S-13, drainage system at Reading Packing House Road (St. Johns County)

107. Location/description. This site was visited only during the October 1982 trip and was located at the intersection of Florida Highway 13 and Reading Packing House Road. A large mat of mostly the aquatic morphotype of alligatorweed was observed on both sides of Highway 13 at this intersection. Plants extended 30 to 60 m along the canal (1 to 2 m wide) and in certain places covered the canal completely.

108. October. During the October 1982 trip, this site was predominantly of the aquatic morphotype of alligatorweed, although some terrestrial morphotype was found. Plants appeared moderately stressed by *Agasicles*, and webworm populations were observed on plants of both morphotypes.

Site S-14, St. Johns River near Palatka (Putnam County)

109. Location/description. This site was located at the point where US Highway 17 crosses the St. Johns River near Palatka. Coulson (1977) indicated a release in the St. Johns River near Palatka; however, the exact location was not noted, so various excess points to the river were examined. No alligatorweed was present.

110. June-October. No alligatorweed was observed on either side of the Highway 17 Bridge. An examination was also conducted up- and downriver (5 to 6 km) from the bridge by access roads, and no alligatorweed was found.

Site S-15, drainage ditches south of Gainesville (Alachua County)

111. Location/description. This site consisted of three different areas of the drainage ditch on the west side of US Highway 441, 5 km south of Gainesville. Terrestrial alligatorweed was present in all three ditches.

112. June-October. The terrestrial morphotype of alligatorweed was present in these ditches during both sampling trips (June and October 1982).

Mats varied in size; however, all were about 1 m wide and extended for 20 to 50 m. No insect damage was observed on either trip.

Site S-16, Isla Apopka Lake
east of Inverness (Citrus County)

113. Location/description. This site was located on the north side of Florida Highway 44 near Inverness along the margin of Isla Apopka Lake. Only the terrestrial morphotype was present.

114. June-October. The alligatorweed at this site (2 by 25 m) was the terrestrial morphotype, and no insect damage was observed in June 1982. In October 1982, the alligatorweed had grown taller and was encompassing a larger area (4 by 60 m); however, it was not invading the aquatic habitat. No insect damage was observed on the terrestrial morphotype.

Site S-17, farm pond near
Brooksville (Hernando County)

115. Location/description. This site was located in a small farm pond on the east side of US Highway 41, 3 km north of Brooksville. In June 1983, a 5-m fringe of the aquatic morphotype occurred around the pond margin.

116. June-October. The aquatic morphotype of alligatorweed was present but was severely damaged by *Agasicles* in June 1982. No alligatorweed was observed at this site in October 1982.

Site S-18, Robus Park,
Tampa (Hillsborough County)

117. Location/description. This site was west of Interstate 275 at its intersection with Adalee Street. It was visited only during the October 1982 trip. The lake within the park (approximately 2 ha) had the aquatic morphotype of alligatorweed completely around the edge and extending out 1.5 m. Plants were approximately 35 cm tall and had stem diameters of 0.8 cm.

118. October. In October 1982, the majority of alligatorweed at this site was the aquatic morphotype. It extended around the entire lake and out 1.5 m from the bank. Plants were severely damaged by *Agasicles*, and 30 adults were collected in one 10-m sweep.

Site S-19, Lake Trafford
near Immokalee (Collier County)

119. Location/description. This site was located west of a boat ramp off Florida Highway 846, southwest of Immokalee. A fringe of the aquatic

morphotype of alligatorweed was present. Examination by airboat of other locations within the lake indicated that alligatorweed was present throughout.

120. June. In June 1982, the aquatic form of alligatorweed was present throughout the lake in moderate amounts. Sparse *Agasicles* feeding was observed in June.

Site S-20, canal near
Yeehaw Junction (Osceloa County)

121. Location/description. This site was located in a canal that paralleled the Florida Turnpike on its east side at mile marker 134. The aquatic morphotype was interspersed in a dense mat of waterhyacinth.

122. June. The aquatic morphotype of alligatorweed was observed during the June trip in this canal paralleling the Florida Turnpike. Insect damage was sparse and caused by *Agasicles*.

Site S-21, canal near
Riviera Beach (Palm Beach County)

123. Location/description. This site was located in an east-west canal that crosses US Highway A1A north of Riviera Beach. The canal had an extensive fringe of the aquatic morphotype of alligatorweed.

124. June. In June 1982, an extensive mat (2 by 30 m) of the aquatic morphotype of alligatorweed was present in this small canal. *Agasicles* had severely impacted the vegetation to the extent that the majority of it was bare stems.

Georgia

Site 28, Savannah River
(mouth of Ebenezer Creek
near Ebenezer Landing and Rincon
Effingham County, Ga.-Jasper Co. S. C.)

125. Location/description. This site was located east of Rincon, Ga., on Georgia Highway 275 at Ebenezer Landing. Small amounts of the aquatic morphotype occurred among willow trees north of the boat ramp. There was an extensive area of the terrestrial morphotype.

126. June. A sparse amount of the aquatic morphotype was found just north of the boat ramp under some willow trees. The mat was 3 by 6 m; the plants appeared to be in good condition, were 30 to 35 cm tall, and had stem diameters of 0.4 cm. Two adult *Agasicles* were collected. An extensive growth

of the terrestrial morphotype was also observed, with 15- by 30-m patches being noted in at least four areas (Figure 15). Plants were 15 to 20 cm tall and appeared to have been mowed; no flowers were observed.

127. October. Generally, the aquatic morphotype of alligatorweed was absent in that only 10 to 15 stems were found, and all exhibited typical *Agasicles* feeding damage. Plants were only 5 to 10 cm tall and had stem diameters of 0.5 cm. The terrestrial morphotype was healthy and covered a large area. They ranged from 15 to 20 cm tall and had stem diameters of 0.2 cm. Nearly all (99 percent) of the alligatorweed at this site was the terrestrial morphotype, which exhibited lush growth and no insect damage.

Site 29, canal near
Garden City (Chatham County)

128. Location/description. The site was located in a canal paralleling the west side of Georgia Highway 21, 1 mile south of the Garden City airport.

129. June. A moderate area of alligatorweed (5 by 20 m) was found. Most plants were the aquatic morphotype and ranged in height from 20 to 30 cm. No insects or insect damage was observed.

130. October. A small reduction in the amount of aquatic alligatorweed present was observed in October. Plants exhibited damage, but they were still 30 cm tall. *Agasicles* were present, but were concentrated in particular areas of the mat. The mat was not severely impacted, but *Agasicles* feeding was intense in some areas. No *Vogtia* or *Amynothrips* were collected, and the terrestrial alligatorweed was unchanged from the June sampling.

Site 30, Flint River arm
of Jim Woodruff Reservoir
near Faceville (Decatur County)

131. Location/description. This site was located in Bainbridge, Ga., at the Earl May Boat Basin south of the US Highway 27 Bridge. Both morphotypes of alligatorweed were present, but neither was abundant.

132. June. Alligatorweed was very sparse at this site, but plants were healthy, about 25 cm tall. Both the terrestrial and aquatic morphotypes were present, but no insects were observed on either.

133. October. Only 10 to 15 stems of the aquatic morphotype were found, but they were severely impacted. The plants were defoliated, had stem diameters of 0.6 cm, and were 7 to 10 cm above the water surface. *Agasicles*

feeding was intense, and three adults were collected. No *Vogtia* or *Amynothrips* were observed. The terrestrial morphotype had no damage.

Louisiana

Site 31, Black Bayou Lake near Vivian (Caddo Parish)

134. Location/description. This site was located at the spillway of the lake on the south side of Louisiana Highway 2. A large area of the terrestrial morphotype was present on the spillway banks, extending 3 to 5 m above the shoreline.

135. June. A large amount of the terrestrial morphotype was present on the east side of the spillway. In some areas, the mat extended to a distance of 3 to 5 m above the shoreline. Plants were 10 to 15 cm tall and had stem diameters of 0.2 cm. The aquatic morphotype occurred in small clumps near the shore. Both morphotypes were healthy and had no damage, and no insects were collected.

136. October. The large area of terrestrial alligatorweed east of the spillway had been bulldozed, and most of the topsoil had been removed. A few small clumps (0.5 by 1 m) of the terrestrial morphotype remained. Plants were 10 to 15 cm tall and had stem diameters of 0.4 cm. The aquatic morphotype was present in small amounts. Plants were 20 to 25 cm tall and had diameters of 0.4 cm. No insect damage or insects were observed on either morphotype.

Site 32, Toledo Bend Reservoir at Logansport (DeSoto Parish)

137. Location/description. The site was located on the west side of the Toledo Bend Reservoir where US Highway 84 crosses the reservoir. Four small mats of the aquatic morphotype (1 by 1.5 m) occurred in a backwater area near a boat ramp. Terrestrial alligatorweed was intermingled in the vegetation on the bank.

138. June. Sparse amounts of the aquatic morphotype were found in a backwater area of Toledo Bend Reservoir. Plants in four mats (1 by 1.5 m) appeared healthy, were 10 to 15 cm tall, and had stem diameters of 0.3 cm. Terrestrial alligatorweed was present on the bank. No *Agasicles*, *Vogtia*, or *Amynothrips* were collected, and no insect damage was noted on aquatic or terrestrial alligatorweed.

139. October. The water level had decreased, and the alligatorweed mats were completely dry. The mats were still small (1 by 2 m), and plants were 25 cm tall with stem diameters of 0.3 cm. All plants exhibited the characteristics of the terrestrial morphotype. No insect damage was observed.

Site 33, Round-a-way Bayou
near Tallulah (Madison Parish)

140. Location/description. The site was located at the bridge where US Highway 65 crosses Round-a-way Bayou. A 0.5-m fringe of the terrestrial morphotype occurred along the margin of the bayou.

141. June. A small fringe (0.5 m) of the terrestrial morphotype was observed at this site. Plants were 20 cm tall, and their stems were 0.3 cm in diameter. No biocontrol insects were found.

142. October. A small fringe (0.05 m) of terrestrial alligatorweed was present, but no biocontrol insects were found.

Site 34, Lake Bushy near
St. Joseph (Tensas Parish)

143. Location/description. The site was a backwater lake (Lake Bushy also called Bushy Bayou) connected to Lake Bruin. An extensive mat of the aquatic morphotype occurred for a distance of 10 m around the lake margin, and floating mats were observed throughout the lake.

144. June. An extensive amount of alligatorweed was present. The mat extended 10 m from the shore into the lake, with numerous floating mats occurring throughout the lake. Most of the plants were the aquatic morphotype (80 percent). They were 40 to 50 cm tall and had stem diameters of 0.8 cm. *Vogtia* damage was noted, along with *Agasicles* feeding, but both occurred at low levels. *Amynothrips* were not found.

145. October. The water level of the lake had decreased. Most plants exhibited the terrestrial morphotype (80 percent). Plants were 35 to 40 cm tall and had stem diameters of 0.7 to 0.8 cm. They were fibrous and tough when broken. No biocontrol insects were found, but webworms were present in low numbers.

Site 35, Ruddock Canal near
Ruddock (St. John the Baptist Parish)

146. Location/description. This site was located on US Highway 51 just north of Ruddock. This is probably the site that Coulson (1977) referred to

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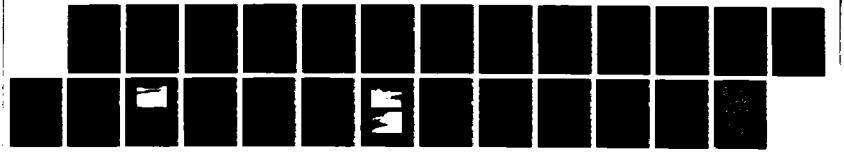

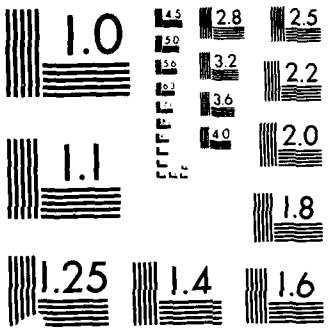

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as Jasmine Bayou. The alligatorweed mat was extensive (25 by 100 m). Plants were mostly the aquatic morphotype (70 percent).

147. June. The alligatorweed mat was extensive (25 by 100 m). Plants were mostly the aquatic morphotype (70 percent), were 40 cm in height, and had stem diameters of 0.5 cm. Three small areas of *Vogtia* damage were observed. *Amynothrips* were collected, but no *Agasicles* damage was evident.

148. October. The aquatic morphotype of alligatorweed was extensively damaged. Almost all stems were defoliated, were 20 cm tall, and had stem diameters of 0.5 cm. Twenty-three *Agasicles* (adults and larvae) were collected in three sweep transects. *Vogtia* damage was also noted, but no *Amynothrips* damage or insects were observed.

Site 36, Shell
Bank Bayou between Lake
Maurepas and Lake Pontchar-
train, (St. John the Baptist Parish)

149. Location/description. This site was located in Shell Bank Bayou at a burned-out bridge on an abandoned highway that paralleled US Highway 51 between Lake Maurepas and Lake Ponchartrain. It is 8 km north of the I-10 interchange with US Highway 51. The entire surface of the bayou was covered by the aquatic morphotype for a distance of 250 m towards Lake Ponchartrain and 50 m toward Lake Maurepas. Plants were 50 to 60 cm in height.

150. June. A large aquatic alligatorweed mat (50 by 250 m) was present on the east side of Highway 51, and a smaller mat (50 by 50 m) was on the west side of the highway. The plants were 50 to 60 cm tall and had stem diameters of 0.9 cm. Most plants were the aquatic morphotype, but a small amount of the terrestrial morphotype was present (Figure 17a). *Vogtia* damage was scattered in the mat, with *Vogtia* larvae being collected in all damaged areas. No *Agasicles* or *Amynothrips* damage was observed.

151. October. Alligatorweed was still present, but the mat was severely impacted by both *Agasicles* and *Vogtia* (Figure 17b). A large amount of the aquatic morphotype still existed below the water surface. Emergent plants were 10 to 20 cm tall and had stem diameters of 0.2 to 0.8 cm. Forty-three *Agasicles* (adults and larvae) were collected, along with four *Vogtia* larvae. No *Amynothrips* were observed.

Site 37, borrow pit near
Norco (St. Charles Parish)

152. Location/description. This site was located just east of Louisiana Highway 626 in a borrow pit that paralleled US Highway 61. Mainly the aquatic morphotype of alligatorweed was present at this site. The mat was 30 by 60 m, and plants were healthy, being 30 to 35 cm tall.

153. June. The aquatic alligatorweed mat was healthy and extended 30 by 60 m. A sparse amount of terrestrial alligatorweed was observed. Plants were 30 to 35 cm in height and had stem diameters of 0.6 cm. *Vogtia* were producing the greatest amount of damage, but *Agasicles* feeding was also observed. Six *Vogtia* larvae and one pupa were collected, but only one adult *Agasicles* was collected. No *Amynothrips* were found.

154. October. No aquatic alligatorweed was present. The entire area was covered by waterhyacinth. A sparse amount of terrestrial alligatorweed was present along the bank. No biocontrol insects were collected.

Site 38, Cross Canal
on US Highway 61 near
New Orleans Airport (St. Charles Parish)

155. Location/description. This site was located west of the New Orleans International Airport in the canal that parallels US Highway 61 to the north. A dense mat of the aquatic morphotype occurred in a 15- by 30-m area of the canal.

156. June. Alligatorweed was concentrated near the highway and consisted of both morphotypes. The total mat covered only a 15- by 30-m area. The plants appeared healthy, were 25 to 30 cm tall, and had stem diameters of 0.5 cm. Moderate *Vogtia* damage was observed, along with some *Agasicles* feeding damage. Three *Vogtia* larvae and one *Agasicles* adult were collected. No *Amynothrips* were present.

157. October. The aquatic morphotype was absent, and a waterhyacinth mat occupied the area where alligatorweed had been observed. The terrestrial morphotype was still present and healthy. Plants were 30 cm tall and had stem diameters of 0.3 cm. No biocontrol insects were present.

Site 39, near Warren Canal
south of Kaplan (Vermilion Parish)

158. Location/description. This site was located south of Kaplan where Louisiana Highway 35 crosses a drainage canal (adjacent to the house No. 632). The canal was approximately 12 m wide and extended a distance of 3 km in a

western direction. A mat of the aquatic morphotype covered the entire canal surface except for occasional small areas of open water. Plants were 35 to 40 cm in height. A small amount of the terrestrial morphotype was also observed along the bank.

159. June. A large infestation of aquatic alligatorweed occurred in this canal, which was approximately 3 km long and 12 m wide. Some portions of the canal were completely covered by aquatic alligatorweed. Clumps of terrestrial alligatorweed were observed along the bank and were undamaged. Plants of the aquatic morphotype were 35 to 40 cm tall and had stem diameters of 0.6 cm. *Vogtia* larvae were collected, but damage was localized. No *Agasicles* or *Amynothrips* were observed.

160. October. A large population of aquatic alligatorweed was still present. Plants were healthy, 15 to 20 cm tall, and had stem diameters of 0.7 cm. A moderate *Agasicles* population was present, but no *Vogtia* or *Amynothrips* were observed. The terrestrial alligatorweed appeared to be at the same level; however, plants had increased in height.

Site 40, Bayou Lafourche
near Thibodaux (Lafourche Parish)

161. Location/description. This site was located in Bayou Lafourche, 9.5 km south of Thibodaux off Louisiana Highway 1 near the St. Charles Elementary School. Only a small amount of the aquatic and terrestrial morphotype of alligatorweed was found.

162. June. A small amount of alligatorweed (both morphotypes) was present at this site. Aquatic alligatorweed was 20 cm tall and 0.4 cm in stem diameter. Extensive *Agasicles* damage was observed, but no *Vogtia* or *Amynothrips* damage was found.

163. October. No aquatic alligatorweed was found; however, small clumps of terrestrial alligatorweed were observed.

Site 41, borrow pit
near Gibson (Terrebonne Parish)

164. Location/description. This site was located on the south side of Louisiana State Highway 20, 1.5 km east of Gibson. The large alligatorweed mat that occurred at this site was composed of both the aquatic (90 percent) and terrestrial (10 percent) morphotypes. Plants were healthy and completely covered the canal (20 to 22 m wide) in some areas.

165. June. Large alligatorweed mats occurred along 3 km of the canal and completely covered it in some areas. Alligatorweed was primarily the aquatic morthotype (90 percent) (Figure 18a). Plants were healthy, were 40 cm in height, had stem diameters of 0.5 cm, and were just starting to flower. A moderate population of *Agasicles* was observed, along with a small amount of *Vogtia* damage. No *Amynothrips* or their damage was observed.

166. October. The aquatic alligatorweed population was severely damaged (Figure 18b). Plants were defoliated, stood 25 to 30 cm tall, and had stem diameters of 0.8 cm. Thirty-one *Agasicles* adults and larvae were collected in three sweeps, but no *Vogtia* or *Amynothrips* were observed. Terrestrial alligatorweed exhibited no damage and had increased slightly from the June sampling period.

Site S-22, drainage ditches
south of Kaplan (Vermilion Parish)

167. Location/description. This site was located south of Kaplan in roadside ditches along Louisiana Highway 35 between Kaplan and the Intracoastal Waterway. Most roadside ditches had mats of alligatorweed, primarily the terrestrial morphotype. Alligatorweed was also observed in numerous lateral rice irrigation canals in the area.

168. June-October. This site had mostly the terrestrial morphotype of alligatorweed, which was undamaged by insects during both sampling trips. The small amount of aquatic morphotype present was severely impacted by *Vogtia* in June 1982. In October, a lush mat of aquatic alligatorweed was present, and only a sparse amount of *Agasicles* damage was observed.

Site S-23, irrigation pond
near Ester (Vermilion Parish)

169. Location/description. This site was located in an irrigation pond off Louisiana Highway 82, 11 km west of Ester. The site had approximately 12 ha of the terrestrial morphotype.

170. June-October. This pond had the terrestrial morphotype of alligatorweed present during both trips (June and October 1982). No insect damage was ever observed on the alligatorweed that covered almost the entire site.

Site S-24, roadside ditch near
Morgan City (Terrebonne Parish)

171. Location/description. This site was located in a roadside ditch along US Highway 90, 12 km east of Morgan City. The aquatic morphotype of alligatorweed was interspersed with waterhyacinth.

172. June-October. In June 1982, the predominant form of alligatorweed was the aquatic morphotype that had sparse *Agasicles* feeding. In October 1984, the canal had no aquatic vegetation present; it appeared to have been sprayed. The only alligatorweed present at this site in October was undamaged terrestrial alligatorweed on the bank.

Site S-25, roadside ditches
along US Highway 51 between Manchac
and Ponchatoula (Tangipahoa Parish)

173. Location/description. This site was located in the roadside ditches on both sides of US Highway 51 between Lake Ponchartrain and Ponchatoula. In areas where the ditches held water for long periods, the alligatorweed mats were primarily the aquatic morphotype. Otherwise, the terrestrial morphotype was dominant.

174. June-October. Both aquatic and terrestrial morphotypes of alligatorweed were present in the ditches along US Highway 51 between Manchac and Ponchatoula with the aquatic morphotype being more dominant. Plants were healthy, but *Agasicles* and *Vogtia* damage was noted in June 1984. In October 1982, the plants were severely impacted, predominately by *Agasicles*; however, *Vogtia* damage was also observed.

Mississippi

Site 42, Bogue Phalia near
Greenville (Washington County)

175. Location/description. This site was located at the point where US Highway 82 crosses the Bogue Phalia Bayou in Leland. No alligatorweed was present.

176. June-October. No alligatorweed was found at this site. Coulson (1977) reported a release of *Agasicles* on the Bogue Phalia near Greenville; however, where the exact release was made could not be determined.

Site 43, sewage lagoon
at Jackson (Hinds County)

177. Location/description. This site was located at the Jackson, Miss., municipal sewage treatment plant south of Interstate-20 on Interstate-55. There were six interconnected treatment lagoons. A mat of alligatorweed was present in the first treatment lagoon east of the pumping station. Most of the plants were the terrestrial morphotype. *Bidens* spp. and *Polygonum* spp. were apparently outcompeting the small amount of aquatic morphotype present.

178. June. Alligatorweed was found in the first lagoon east of the pumping station, with the terrestrial morphotype being predominant. *Bidens* and *Polygonum* appeared to be outcompeting the aquatic morphotype of alligatorweed. The total acreage was difficult to determine. Terrestrial alligatorweed was distributed over a 6- by 25-m area and appeared to be at a moderate level. The aquatic morphotype was sparse and intermingled with other aquatic plants along the shore, forming a fringe (1 by 20 m). The terrestrial morphotype may have been subjected to mowing. Plants were approximately 15 cm tall and were flowering. The alligatorweed was healthy, with no feeding damage except for a small amount of leaf twisting caused by a sparse *Amynothrips* population. No *Agasicles* or *Vogtia* were collected. A similar amount of alligatorweed was observed at the other end of this lagoon.

179. October. The terrestrial morphotype had been partially mowed but covered the same general area as in June. The aquatic morphotype ranged from 15 to 40 cm tall, and the mat extended 1 m from the shore. Total acreage was similar to that observed in June. Aquatic alligatorweed was severely damaged, with numerous defoliated stems. *Agasicles* adults were collected, and webworms were found in the apical portion of both morphotypes. *Amynothrips* were not found.

Site 44, Benard Bayou
near Gulfport (Harrison County)

180. Location/description. The site was located where Mississippi Highway 49 and Interstate-10 cross Benard Bayou. No alligatorweed was present.

181. June-October. This was the first area where *Agasicles* were released in Mississippi (1965). Sampling was conducted at two locations (US

Highway 49 and Interstate-10) because the exact release area could not be located. No alligatorweed was found.

Site S-26, Ross Barnett
Reservoir near Canton (Madison County)

182. Location/description. This site was located on the northwest shore of Ross Barnett Reservoir off the Natchez Trace Parkway. Mats of aquatic and terrestrial morphotypes were present on the northwest side of the road.

183. June-October. The aquatic and terrestrial morphotypes of alligatorweed were observed on the northwest side of the reservoir. Plants were healthy and had no insect damage during the June 1982 trip. In October 1982, the alligatorweed was being impacted by *Vogtia*, but a large amount of biomass still appeared healthy. No *Agasicles* or their feeding was observed.

Site S-27, catfish
ponds at D'Lo (Simpson County)

184. Location/description. This site was located approximately 1 mile west of US Highway 49 in D'Lo, Miss. The aquatic morphotype of alligatorweed was dominant, with a small amount of the terrestrial morphotype being found on the edge of the pond and on the dam between the two catfish ponds. The aquatic alligatorweed produced a fringe growth around the entire bank of both lakes and extended 2 m into the lake in certain areas.

185. June-October. The aquatic and terrestrial morphotypes were both present at this site in June 1982. No insect damage was observed on the aquatic alligatorweed; however, *Amynothrips* were observed on the terrestrial morphotype. In October 1982, the aquatic morphotype increased. *Vogtia* damage was observed throughout the site, but damage was sparse to moderate. No *Agasicles* were observed. The terrestrial morphotype was still present but did not appear to be spreading, and the *Amynothrips* were still observed in low numbers.

North Carolina

Site 45, Catherine Creek
near Ahoskie (Hertford County)

186. Location/description. This site was located in Horse Swamp where North Carolina Highway 1409 crosses Catherine Creek. Alligatorweed occurred

on a 1- to 2-m-wide mud flat that extended on both sides of the bridge for 30 to 60 m. Plants were primarily the terrestrial morphotype, although the stems appeared somewhat hollow. Silt and mud occurred on the vegetation 1 m above the present waterline, indicating that the stream water level had been much higher recently.

187. June. Dense alligatorweed mats were observed on both sides of the highway. Terrestrial alligatorweed plants were the dominant morphotype and were generally confined to a 1- to 2-m-wide mud flat that extended 30 to 60 m along the entire stream. A floating mat of aquatic alligatorweed (1 by 2 m) was found only in a pool area next to the bridge on the east side. Plants were 15 to 20 cm tall, with hollow stems averaging 0.3 cm in diameter. This stream had had high flows recently, as evidenced by mud and silt on the alligatorweed foliage. No insect damage was observed, and no biological control insects were found.

188. October. The alligatorweed mat was still dense. Floating alligatorweed extended from the mud flat into the stream. Plants were 25 cm tall and had stem diameters of 0.5 cm. Silt and mud were observed on vegetation to a height of 1 m above the existing water level, indicating that the stream had experienced high flow rates recently. Characteristic *Vogtia* damage was located in two small areas (1 by 1.5 m), but no larvae were found. No other biocontrol insects were found.

Site 46, stream near
Columbia (Tyrrell County)

189. Location/description. This site was located at a small stream 0.16 km south of Columbia, N. C. on North Carolina Highway 94. Alligatorweed occurred on both sides of the bridge, but the mat extended only 5 to 6 m on the east side with a small amount of fringe growth (1 to 1.5 m). The stream had no alligatorweed for the first 30 to 50 m on the west side of the bridge, but the alligatorweed mat extended from the banks beyond this point. Approximately 15 percent of the alligatorweed was the terrestrial morphotype.

190. June. Alligatorweed mats of both morphotypes were present on both sides of the bridge. The mat extended 5 to 6 m from the bridge on the east side. Some fringe growth was present 1 to 2 m from the shore but was intermittent (Figure 19a). These flowering plants were 20 to 25 cm tall and had stem diameters of 0.4 cm. Alligatorweed on the west of the bridge was found 30 to 50 m from the bridge and in a small canal to the southwest. These mats

were dense, but the area next to the bridge was open water. Overall, 85 percent of the alligatorweed at this site was the aquatic morphotype, and no biocontrol insects or damage was observed.

191. October. The total acreage of alligatorweed had increased (Figure 19b), and was mainly the aquatic morphotype. The mat on the east side extended 12 to 15 m along the shore and covered the entire stream. Alligatorweed on the west side almost completely covered the 30 to 50 m of open water that had been observed in the first trip. Plants were 40 to 50 cm tall and had stem diameters of 0.5 to 0.6 cm. A large amount of *Vogtia* damage was observed, and larvae were easily collected. Damage from a moderate population of webworms was also observed. No *Agasicles* or *Amynothrips* were observed.

Site 47, Conaby Creek in Plymouth (Washington County)

192. Location/description. The site was located at a bridge across Conaby Creek on North Carolina Highway 64. The creek was about 60 percent covered by the aquatic morphotype to the north of the bridge, and there was also a fringe of the terrestrial morphotype. A dense mat of alligatorweed extended a short distance south of the bridge but was restricted by an overhanging tree canopy.

193. June. Alligatorweed was most abundant on the north side of the bridge, extending 3 m from both shores along the 150-m distance to the railroad bridge. Overall, this site had a 60-percent coverage of alligatorweed (Figure 20a). Plants had hollow stems that were 0.8 cm in diameter, were 50 to 60 cm in height, and were starting to flower. Ninety percent of the alligatorweed present was the aquatic morphotype. A smaller amount of alligatorweed was observed on the south side of the bridge. Floating mats (2 by 3 m) were observed close to the bridge, and a small fringe (1 to 2 m) extended down the shore on both sides for 6 m. No biocontrol insects or insect damage was found on either side of the bridge.

194. October. The alligatorweed mat on the north side of the bridge covered a much larger area (Figure 20b), but it was extensively damaged. Plants were 20 to 40 cm tall and 0.6 cm in stem diameters. Abundant *Agasicles*-type feeding was observed in many areas where groups of stems were completely defoliated. These damaged areas were surrounded by lush growth that had none of this feeding damage. Terrestrial alligatorweed was also

present, but no insect damage was observed. No *Agasicles* or *Amynothrips* were found. *Vogtia* larvae were abundant on the aquatic morphotype.

Site 48, Greenfield Lake,
Wilmington (New Hanover County)

195. Location/description. Two different areas of alligatorweed were examined at this site. The first area was located at the lake spillway on US Highway 421. A 1- to 3-m mat of the aquatic morphotype was present. The second area was a small stream that ran into the southeast side of the lake near the intersection of Heart and Lake Shore drives. A very small mat of the aquatic morphotype was observed.

196. June. A small mat (1 by 3 m) of aquatic alligatorweed was located in the spillway area. Plants were 20 to 25 cm tall and had stem diameters of 0.4 cm. Additional plants (5 to 10 stems) of the terrestrial morphotype were found in a small stream on the southeast side of the lake. These plants were 10 cm tall and had stem diameters of 0.3 cm. No biocontrol insects were found at either location.

197. October. Approximately the same amount of alligatorweed was present in both locations. Plants appeared healthy and were taller (35 cm). No insect damage or biocontrol insects were observed.

Site 49, roadside canals
near *USS North Carolina*, Cape Fear
River, Wilmington (New Hanover County)

198. Location/description. Two canals located on either side of North Carolina Highway 1352 in front of the battleship *USS North Carolina* were observed. The canal on the north side of the road was 6 m wide by 50 m long and was 25 percent covered with alligatorweed. The canal on the south side of the road was 6 m wide by 60 m long and was 80 percent covered with alligatorweed. Plants in both canals were similar in height. Only a small portion of the terrestrial morphotype was present along the shore.

199. June. A large amount of alligatorweed was located in two small canals near the *USS North Carolina*, the majority of which was the aquatic morphotype. Plants were 50 to 60 cm tall and had hollow stems with diameters of 0.9 to 1.1 cm. Eighty percent of the southern canal (6 by 60 m) and 25 percent of the northern canal (6 by 50 m) were covered by alligatorweed (Figure 21a). Plants were lush and extremely healthy, with no sign of insect damage.

200. October. The aquatic alligatorweed mats had increased, covering 95 percent of the southern canal and 50 to 60 percent of the northern canal (Figure 21b). More *Vogtia* damage appeared to be in the northern canal than in the southern canal. *Vogtia* larvae were collected from both canals but were more abundant in the northern canal. Webworms were also found in both canals, but the population was only moderate. A small area having *Agasicles*-type feeding (2 by 2 m) was observed, but no adults or larvae were observed.

Site 50, Lake
Waccamaw (Columbus County)

201. Location/description. Two areas of alligatorweed were examined. The first area was located west of North Carolina Highway 214 on the road that follows along the northwest side of the lake. Alligatorweed was found in the canal (20 by 1.6 km) on the northern side parallel to the road. This canal was connected to Lake Waccamaw at various points and was a release area for *Agasicles* in 1979. Most of the canal had a 3- to 5-m fringe of alligatorweed, but the mat extended completely across some portions of the canal. The aquatic morphotype was predominant (95 percent), and most of the plants were flowering. The second area examined was an original release site for *Agasicles* in 1967. This site was located in a canal on the northeastern side of the lake at the junction of North Carolina Highway 1947 and Friar Swamp. This canal (10 to 15 m wide) parallels the road for about 3 km and is connected to the lake at various points. An intermittent fringe (1 to 2 m) of alligatorweed was present along the shore of the canal. There also were a small number of floating mats within the canal.

202. June. One observation area was a 2-m-wide by 1.6-km-long canal. Most of the shore had a 3- to 5-m fringe of aquatic alligatorweed. Many large, floating mats were observed throughout the canal, and the mat extended across the entire canal in some areas. Terrestrial alligatorweed was also present at low levels on the bank. The plants, which were flowering, were relatively large, with heights of 40 to 50 cm and stem diameters of 1.2 cm. *Vogtia*-type damage was noted in three separate locations (1 each by 2 m), but no larvae were observed. No other insect damage was observed on the vegetation, and no biocontrol insects were observed. A second canal (10 to 15 m wide and about 2 km long) was also examined at Lake Waccamaw. Alligatorweed was not as abundant as in the other area. The fringe of alligatorweed was not

continuous along the shore, and there were only a small number of small floating mats. No insect damage was observed.

203. October. An extensive aquatic alligatorweed mat was still present in the first canal. Plants were 30 to 40 cm tall and had stem diameters of 0.4 to 0.5 cm. Some portions of the large mats were severely damaged. *Vogtia* damage was noted in various areas, and larvae were collected. The alligatorweed had been defoliated in many areas (similar to damage caused by *Agasicles*), but no adults or larvae were found. Webworms were also found in relatively large numbers and were causing damage to the apical portion of some plants. The second canal had less alligatorweed than in June. Plants were 30 cm tall and had stem diameters of 0.4 cm. *Vogtia* larvae were collected throughout the area. Webworms were also found on the apical portions of these plants. No *Agasicles*-type feeding was noted, and no *Amynothrips* were observed.

Site 51, farm drainage ditch
at Chadbourn (Columbia County)

204. Location/description. Ditches along both sides of North Carolina Highway 1564 had alligatorweed mats. These mats extended 120 m on the east side of the road and 60 m on the west side and had a width of 1 m. Plants were 10 to 15 cm tall and had diameters of 0.2 cm. They were the terrestrial morphotype.

205. June. An alligatorweed mat in a drainage ditch on the east side of North Carolina Highway 1564 covered an area 1 by 120 m, and alligatorweed on the west side of the road extended 1 by 60 m. Plants were about to flower, were short (10 to 15 cm), and had stem diameters of 0.2 cm. Water was present in the drainage ditch, but this appeared to be a temporary condition. No insect or insect damage was observed.

206. October. Alligatorweed was still present on both sides of the road. Plants were short, (5 to 10 cm), with stem diameters of 0.1 to 0.2 cm, and they appeared stressed. Apical leaves were black and dying. The landowner indicated that no chemicals had been used, but the damage appeared similar to that caused by chemicals. No biocontrol insects were found.

Site S-28, small farm pond
near Kingston (Onslow County)

207. Location/description. This site was located west of US Highway 258, approximately 20 miles south of Kingston. A 60- by 12-m mat of mostly the aquatic morphotype occurred along the pond margin.

208. June. In June 1982, this site had a 6- by 12-m mat of the aquatic morphotype occurring along with a small fringe of the terrestrial form. No insect damage was observed.

Site S-29, Kendrick Creek
near Roper (Washington County)

209. Location/description. This site was located in a stream that crossed under US Highway 64, 4 km east of Roper. A fringe of the aquatic morphotype extended 1 to 2 m into the stream.

210. June-October. Alligatorweed was present primarily as the aquatic morphotype and extended 1 to 2 m into the stream. No insect damage was observed in June 1982; however, *Vogtia* damage was observed in October 1982 in sparse to moderate intensity. The size of the alligatorweed mat in October had increased.

Site S-30, west
side of Scuppernong
River near Columbia (Tyrrell County)

211. Location/description. This site was located on the land mass between the eastbound and westbound US Highway 64 bridges across the river, immediately west of Columbia. A large area of exposed alligatorweed was observed, but all plants were the aquatic morphotype. This suggested that either the area is inundated on a regular basis or that water levels were abnormally low.

212. June-October. In June 1982, the alligatorweed was completely out of the water; however, the plants had large stems, similar to the aquatic morphotype. Alligatorweed was the dominant vegetation over the entire area, but no insect damage was observed on any of the plants. In October 1982, sparse damage from *Vogtia* and webworms was observed. Plants were generally healthy, were still out of the water, and had characteristics of the aquatic morphotype.

Site S-31, Queen Anne
Creek in Edenton (Chowan County)

213. Location/description. This site was located in a small backwater area off West Queen Street in Edenton. An extensive mat of the aquatic morphotype occurred along the margin of the area for a distance of 100 m.

214. October. In October 1982, the site had an extensive mat of aquatic alligatorweed occurring along the margin of the area for a distance of 100 yd with terrestrial alligatorweed being present on the bank. Plants were healthy, and no insect damage was observed.

South Carolina

Site 52, Santee River
(Santee-Cooper Reservoir) at the
Low Falls Boat Landing in Halfway
Swamp near Lone Star (Calhoun County)

215. Location/description. This site was located off South Carolina State Road 267 at the Low Falls Boat Landing on Lake Marion.

216. June-October. No alligatorweed was present. Water primrose was occupying the area where alligatorweed had been (Figure A1).

Site 53, North Fork
of Edisto River near
Rowesville (Orangeburg County)

217. Location/description. The site was located at the bridge where the South Carolina Highway from Rowesville to Bamberg crosses the North Fork of the Edisto River. Only a small amount of alligatorweed was present, and plants were primarily the aquatic morphotype.

218. June. The alligatorweed mat was generally restricted to the fringe. Outcroppings (2 by 5 m) of alligatorweed occurred intermittently along the shore on the north side of the bridge. Only two small mats (1 by 3 m) were observed on the south side of the bridge. Plants at this site were generally 35 to 40 cm tall and had stem diameters of 0.6 mm. The aquatic morphotype accounted for 75 percent of the alligatorweed. No insect damage was observed at this site, but some grazing by cattle was noted.

219. October. The alligatorweed was severely damaged. The plants, which were 7 to 8 cm tall with stem diameters of 0.3 cm, appeared to represent regrowth. No *Agasicles* were found, even though most of the damage appeared to

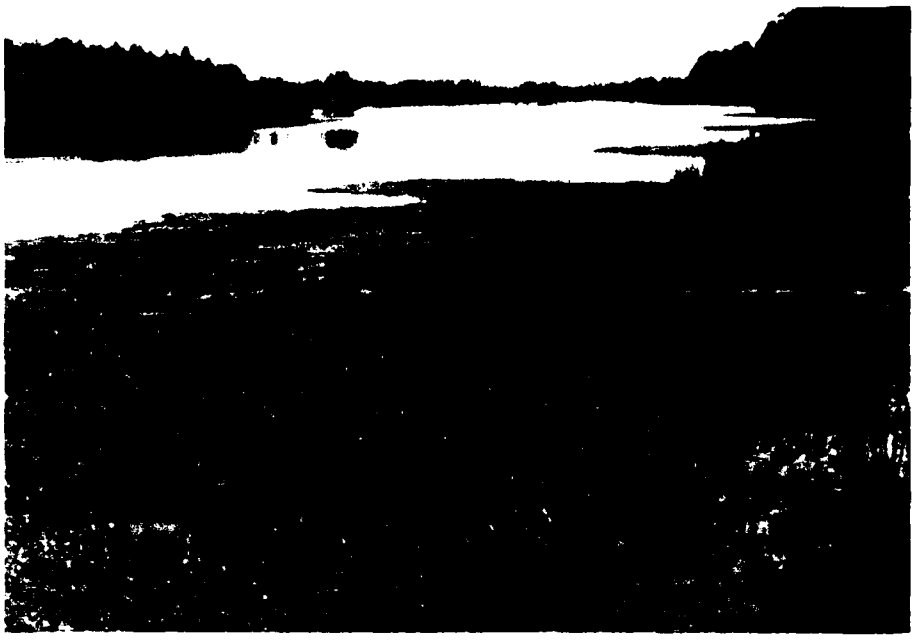


Figure A1. Site 52--Low Falls Boat Landing (Calhoun County), South Carolina. This was an original release site for *Agasicles* in 1967. No alligatorweed was found; however, a thick mat of water primrose had taken over the area

be caused by *Agasicles*. Sparse *Vogtia* damage was observed; however, there was almost no suitable plant material for examination. The terrestrial alligatorweed appeared healthy, and no *Amynothrips* were found.

Site 54, Branchville
on the North Fork of
Edisto River (Orangeburg County)

220. Location/description. This site was located approximately 10 km northwest of Branchville on South Carolina State Road 332 where it crosses the North Fork of the Edisto River. The observation point was the second highway bridge from Branchville. Alligatorweed was abundant on both sides of the bridge and extended completely across the river about 60 m north of the bridge. Approximately 85 percent of the plants were the aquatic morphotype.

221. June. Both morphotypes were present on both sides of the bridge with the aquatic morphotype being very abundant. Alligatorweed extended 2 m from the shore for a distance of 60 m both up and down the river (Figure 24a).

The mat on the north side of the bridge extended completely across the river 60 m upstream. No insect damage was observed from *Agasicles* or *Amynothrips*; however, one *Vogtia* larva was collected.

222. October. The aquatic morphotype had been extensively damaged (Figure 24b). Only 25 to 30 percent of the original mat remained, and plants were 15 to 20 cm tall with stem diameters of 0.5 cm. The terrestrial plants were healthy, were growing, and had little damage. The aquatic morphotype was intensively defoliated, but only a few *Agasicles* were observed. Heavy *Vogtia* damage was also noted, and larvae were collected (Figure 24b). Webworms were found on both morphotypes, but no *Amynothrips* were observed.

Site 55, Goose Creek Reservoir
near Charleston (Berkeley County)

223. Location/description. This site was located where North Rhett Road crosses Goose Creek Reservoir. Only a small (1-sq-m) mat of the terrestrial morphotype was present on the shore of the northwest side of the bridge.

224. June. A small amount (1 sq m) of the terrestrial morphotype was present on the northwest side of the bridge. Plants were 20 cm tall with stem diameters of 0.3 cm. No biocontrol insects were observed.

225. October. The small mat of alligatorweed was still present. Plants were 30 cm tall with stem diameters of 0.4 cm. No insect feeding was observed.

Site 56, O'Neals Lake on Duck
Creek, tributary of Coosawhatchie
River, near Fairfax (Allendale County)

226. Location/description. This site was located on a farm-to-market road about 1.6 km northwest of Fairfax at a bridge across Duck Creek. Alligatorweed occurred on both sides of the bridge for a distance of 20 to 25 m, and consisted primarily of the aquatic morphotype, although the terrestrial morphotype occurred on the adjacent streambanks.

227. June. Alligatorweed was present as a fringe (1 m) for 20 to 25 m on both sides of the bridge. Plants were mostly the aquatic morphotype (85 to 90 percent) and were flowering; they were 35 to 40 cm in height and had stem diameters of 0.4 to 0.5 cm. The alligatorweed mat was dense and lush. No insect damage and no biocontrol insects were observed.

228. October. The site had changed very little. The fringe alligatorweed mats were about the same size (20 to 25 m) on each side of the bridge. Plants were not as lush, but their height was 35 to 40 cm with stem diameters of 0.4 cm. *Polygonum* was intermingled in the mats. Some *Agasicles*-type feeding was observed, but no adults or larvae were noted. *Vogtia* and *Amynothrips* were not found.

Site 57, Ashepoo River
near Ashepoo (Colleton County)

229. Location/description. This site was located at the point where US Highway 17 crosses the Ashepoo River. A fringe of the aquatic morphotype extended 1 to 2 m from the shore, but the terrestrial morphotype was also present.

230. June. Alligatorweed was present on the south side of the bridge. Plants extended 1 to 2 m from the shore on both sides of the river. Both the morphotypes were present, but the aquatic morphotype was dominant. The plants were 25 to 30 cm tall and had stem diameters of 0.4 cm. No biocontrol insects or their damage was observed.

231. October. The alligatorweed mats were severely impacted. Plants were 10 to 15 cm tall, and their stems were 0.3 cm in diameter. Stems of the submersed alligatorweed were 0.7 cm in diameter. Damage was caused by both *Vogtia* and *Agasicles*, but *Vogtia* larvae were having the greatest impact. Webworms were also found on both morphotypes, but no *Amynothrips* were found.

Site 58, Remick
Swamp on Combahee River
near Yemassee (Colleton County)

232. Location/description. This site was on US Highway 17A at the bridge across the connection between Remick Swamp and Combahee River. A few small mats of aquatic alligatorweed were present at a boat ramp. No terrestrial alligatorweed was observed.

233. June. Small aquatic alligatorweed mats (2 by 3 m) were present on the southeast side of the bridge. Plants were 35 to 40 cm tall and had stem diameters of 0.4 cm. All plants were the aquatic morphotype, but the water level appeared high. No biocontrol insects were observed or collected from the plant material.

234. October. The small alligatorweed mats observed in June were absent. No other alligatorweed was found on either side of the bridge.

Site 59, Cuckold Creek,
tributary of Combahee River,
near Whitehall (Colleton County)

235. Location/description. The study site was located south of Whitehall, immediately south of the Seaboard Coast Railroad. The area on both sides of the road had vigorously growing aquatic alligatorweed and some scattered terrestrial alligatorweed. The area was under tidal influence.

236. June. Alligatorweed mats on both sides of the road were healthy. The mat on the north side was a 1- by 6-m fringe around a stand of *Typha*, (Figure 23a). The mats on the south side were more extensive, consisting of both a fringe (1 by 10 m) and floating mats (1 sq m). Ninety percent of the plants were the aquatic morphotype, were 40 to 45 cm tall, and had stem diameters of 0.6 cm. No insects or insect damage was observed.

237. October. The alligatorweed mat was greatly reduced (Figure 23b). Only 50 percent of the emergent vegetation remained. The damage appeared to be caused by *Agasicles*, and four adults were collected. A large amount of biomass remained beneath the water surface. Remaining plant stems were only 4 to 8 cm tall, and they had stem diameters of 0.2 cm, whereas the submerged stems were 0.7 cm in diameter.

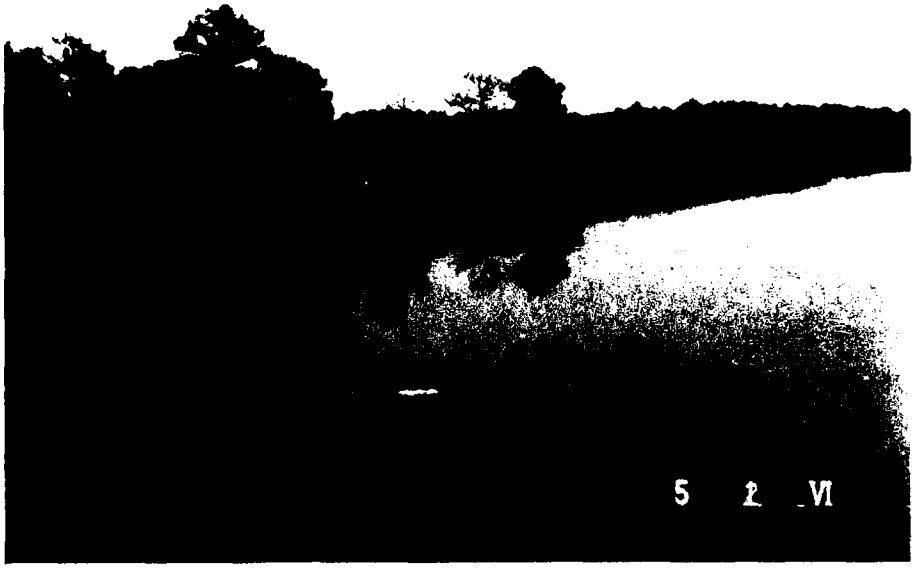
Site 60, Small tributary
of Coosawhatchie and Broad
rivers near Ridgeland (Jasper County)

238. Location/description. This site was located at the point where US Highway 17 crosses the Coosawhatchie River about 12 km north of Ridgeland. No alligatorweed was observed.

239. June-October. No alligatorweed was found (Figure A2).

Site 61, Savannah National
Wildlife Refuge near Hardeeville
(Jasper County) (Pool 2, 5a, 5b)

240. Location/description. The Savannah National Wildlife Refuge is located between Hardeeville, S. C., and Savannah, Ga., on US Highway 17. Pool 2 of the refuge was completely exposed and was covered with a nearly solid stand of the terrestrial morphotype of alligatorweed and *Sesbania*. Together, the pools of the refuge contained more than 1,000 acres of alligatorweed, most of which was the terrestrial morphotype. However, the aquatic morphotype was present in numerous dike canals, especially in the southern portion of the refuge.



a. June 1982

b. October 1982

Figure A2. Site 60--Coosawhatchie River (Jasper County), South Carolina. No alligatorweed was present in June (a) or October 1982 (b)

241. June. A large amount of alligatorweed was present throughout the refuge. Only the terrestrial morphotype was present in Pool 2. Plants had solid stems with diameters of 0.3 cm and were 20 to 25 cm tall. This pool had been dry for a number of months, and the alligatorweed had the appearance of a cover crop. Pools 5a and 5b also had a large amount of alligatorweed, mostly the terrestrial morphotype (Figure 22a). Plants were similar in size to those in Pool 2 and had solid stems. Alligatorweed also completely covered the levee around each pool (Figure 22c). Refuge personnel were attempting to control the alligatorweed by flushing salt water into the pools or by bulldozing pools that were dry. No insect damage was found on either morphotype.

242. October. Pool 2 was still dry, and the low-growing alligatorweed mat was healthy and had a covering canopy of *Sesbania*. Plants were 20 to 30 cm tall and had stem diameters of 0.3 cm. No biocontrol insects or their damage was observed. Pools 5a and 5b had both the aquatic morphotype (35 percent) and the terrestrial morphotype (65 percent). Plants were 35 to 40 cm tall and had stem diameters of 0.5 cm. A large amount of alligatorweed was present, and insect feeding was intense in some areas. Thirty-five adult *Agasicles* were collected, and the *Agasicles* population was high in damaged areas. The overall impact of *Agasicles* was limited by the large amount of plant biomass present and the lateness in the year that the insect population developed. No *Vogtia* or *Amynothrips* were observed. Pool 7, which had been dry in June, also had the aquatic morphotype, which was being impacted by *Agasicles*. However, the damage was scattered.

Site S-32, canal north
of Ridgeland (Jasper County)

243. Location/description. This site was located in a canal (1 m wide) on the east side of Interstate-95 north of Ridgeland between mile markers 27 and 28. A mat of the aquatic morphotype covered a large portion of the canal for a distance of approximately 500 m.

244. June-October. This canal (1 m wide) had the aquatic morphotype of alligatorweed covering a larger portion (500 m) and a fringe of terrestrial alligatorweed. No insect damage was observed in June 1982. In October 1982, sparse damage was observed from both *Agasicles* and *Vogtia*; however, the alligatorweed mat was still very extensive.

Tennessee

Site 62, Moccasin Bend
area of Nickajack Reservoir
near Chattanooga (Hamilton County)

245. Location/description. The location where *Agasicles* were released in the Moccasin Bend area was not specified, so various locations were examined along the Moccasin Bend Pineville Road. No alligatorweed was present at any of the locations examined.

246. June-October. *Agasicles* was the only biocontrol agent released in Tennessee. Examination of various areas of Moccasin Bend was conducted, but no alligatorweed could be located.

Texas

Site 63, Dam B
(Steinhagen Reservoir)
near Beech and Jasper (Jasper County)

247. Location/description. This site was located approximately 1.4 km north of US Highway 190 in the Martin Diez State Park on the east side of the reservoir. A very small area of the terrestrial morphotype, interspersed with *Polygonum* sp. and waterhyacinth, was present. The aquatic morphotype was present, but the mat was not extensive.

248. June. The alligatorweed infestation was moderate and intermingled with other aquatic plant species (*Polygonum*, *Eichhornia*, and *Azolla*). Plants were 20 cm in height and had stem diameters of 0.2 to 0.3 cm. The aquatic morphotype was predominant, accounting for about 80 percent of the population. The *Agasicles* population at this site was very sparse. Only four adults were collected, and damage to the plants was minimal. No other biocontrol agents were observed.

249. October. The water level was extremely high. Only small amounts of alligatorweed extended above the water surface, but a large mat of alligatorweed existed below the water surface. Emergent vegetation was 10 to 15 cm tall and had stem diameters of 0.2 cm. The small amount of emergent alligatorweed was severely impacted by *Agasicles*. Seventeen adults were collected. Two *Vogtia* larvae were also collected, but no *Amynothrips* were observed.

Site 64, Winnie (Chambers County)

250. Location/description. The original releases of biological control agents in the Winnie, Tex., area were made by local farmers, and the exact release sites could not be located. The site examined was located in a large drainage ditch (adjacent to the Winnie Fire Department) in the incorporated limits of Winnie, extending eastward from Texas Highway 124. The ditch was approximately 100 m long by 6 m wide. A large mat of the aquatic morphotype occurred throughout the ditch.

251. June. This study site was selected in the incorporated limits of Winnie. The aquatic alligatorweed mat (6 by 100 m) was very thick and healthy (Figure 25a). Plants were 40 to 50 cm tall and had stem diameters of 1.2 cm. Six *Vogtia* larvae were found, but damage was only scattered. No *Agasicles* or *Amynothrips* were observed.

252. October. The aquatic alligatorweed had been severely impacted (Figure 25b). Both *Vogtia* and *Agasicles* damage and individuals were found. Plants were 10 to 15 cm tall and had stem diameters of 0.4 cm. They appeared to be regrowth from a submerged mat. No *Amynothrips* were observed.

Site 65, Trinity River at
Wallisville Reservoir (Chambers County)

253. Location/description. This site was located on the Trinity River where Interstate-10 crosses the river. A sparse stand of the aquatic morphotype was interspersed in a waterhyacinth mat on the east side of the river. On the west side of the river was an area of approximately 6 ha of alligatorweed, the majority of which was the terrestrial morphotype.

254. June. The aquatic morphotype of alligatorweed was interspersed with waterhyacinth on the east side of the Trinity River, and some terrestrial morphotype was also present. Plants were 35 cm tall and had stem diameters of 0.4 cm. Intense *Agasicles* feeding was noted, and adults were collected. Also, a large area of the terrestrial morphotype of alligatorweed (6 ha) was about 100 m from the river on the west side. Plants were 40 to 50 cm tall and had solid stems that were 0.5 cm in diameter.

255. October. Aquatic alligatorweed was not present on the east side of the river, but the terrestrial morphotype was still present without damage. Terrestrial alligatorweed on the west side of the river had been mowed recently. No biocontrol insects or their damage was observed.

Site 66, Houston area (Harris County)

256. Location/description. The original release of biological control agents on alligatorweed was conducted by the Harris County Mosquito Control Commission. Coordination was made with commission personnel to determine the locations of original release sites and areas of current problems. They indicated that alligatorweed was not a problem, but they provided directions to the release areas. No alligatorweed was found. Most sites, drainage ditches in the Houston area, had been either dredged or lined with concrete.

Site 67, J. D. Murphree Wildlife Management Area (Jefferson County)

257. Location/description. This site was located in the J. D. Murphree Wildlife Management Area, located west of Port Arthur. This area has 11 compartments, which have had varying degrees of alligatorweed problems. Four compartments (3, 4, 9, and 11) had large amounts of both terrestrial and aquatic alligatorweed. Alligatorweed was also abundant as fringe vegetation in the canal system surrounding the compartments, and some canals were completely blocked.

258. June. Four compartments (3, 4, 9, and 11) were examined, and large amounts of alligatorweed were observed. The aquatic morphotype of alligatorweed was also abundant as fringe vegetation in the canal system surrounding the compartments, with some canals being completely blocked. Aquatic alligatorweed appeared healthy, were 30 to 50 cm in height, and were 0.5 to 1 cm in stem diameter (Figure 26a). *Vogtia* damage was observed, and 12 larvae were collected from various locations (Figure 26b). *Amynothrips* were collected only in compartment 11, where they had been released by WES personnel in 1981. *Agasicles* damage was observed only in compartment 3 and occurred at very low levels.

259. October. The fringe of alligatorweed along the canals was completely absent. This was due to insect feeding and herbicide spraying. Management personnel conducted no herbicide spraying inside the compartments, and the alligatorweed population was severely damaged by insects at some locations (Figure 26c). Adult *Agasicles* and larval *Vogtia* were found in most of the compartments at various degrees of intensity, but *Amynothrips* was restricted to compartment 11. Alligatorweed within the compartments was moderately damaged by the insects. Some areas were severely damaged, whereas others still

had large, healthy alligatorweed mats. Compartment 11 exhibited the greatest reduction of alligatorweed.

Site S-33, roadside
ditch near Raywood (Liberty County)

260. Location/description. This site was located in a roadside ditch on the west side of Texas Highway 770, approximately 32 km north of its intersection with Interstate-10. A dense mat of the terrestrial morphotype was present.

261. June. In June 1982 this site had a dense mat of terrestrial morphotype of alligatorweed. No insect damage was observed.

Site S-34, drainage ditch
near Winnie (Chambers County)

262. Location/description. This site was in a drainage ditch at the intersection of Interstate-10 and Texas Highway 73. A dense mat of the aquatic morphotype occurred in a drainage ditch (1 by 30 m) on the south side of Highway 73.

263. June-October. A dense mat of the aquatic morphotype of alligatorweed was present in June 1984. Sparse *Vogtia* damage was observed in June. In October 1984, only a small fringe of the terrestrial morphotype was present, and none of the aquatic morphotype was found. No insect damage was observed on the terrestrial morphotype.

Site S-35, Jones Creek
near Sugar Land (Fort Bend)

264. Location/description. This site was on State Road 359, 24 km west of Sugar Land at the intersection of Jones Creek and the State Road. Mostly the aquatic morphotype of alligatorweed was present and extended 1 to 1.5 m from the bank up- and downstream.

265. October. Extensive amounts of the aquatic morphotype of alligatorweed were present along the bank and extended 1 to 1.5 m in October 1982. No insect damage was observed on the vegetation.